

Town of Otis - Shadow Flicker Methodology & Modeling

9-10-15

Project Location:

Algerie Rd.
Otis, MA

Methodology:

This summary of methodology is presented to help provide context for how a conservative estimate of actual shadow flicker impacts at representative receptor locations was developed for the project area.

Receptor Identification

A theoretical impact model is useful to screen all receptors that are within (10) rotor diameters of the turbine location. Using theoretical maximum impact modeling, the chart in Figure 1 identifies shadow flicker receptors that that receive greater than (30) shadow flicker hours per year or greater than (30) minutes per day.

Figure 1:

Receptor	Shadow Flicker Hours Per Year: Theoretical (hh:mm)	Shadow Flicker Hours Per Day: Theoretical (hh:mm)
SR1	91:16	1:24
SR2	31:17	0:40
SR3	34:38	0:38
SR7	17:02	0:32
SR9	17:48	0:33
SR10A	15:49	0:30
SR10	16:18	0:30
SR11	23:54	0:36
SR14	48:34	0:37
SR15	33:36	0:32

The locations of these receptors are identified in the attached shadow flicker report.

Real-case Assessment and Methodology

The following real-case assessment was completed in order to better quantify the probable flicker effects on several nearby receptors using statistical data and modeling. In order to determine these statistical results the following inputs and methodology were used:

- Shadow flicker module of WindPRO, version 2.7.486.
- Single GE 1.7 wind turbine with a hub height of 80 meters, and a rotor diameter of 103 meters sited at the Town of Otis, MA Algeria Rd. Site.
- Virtual Met Mast provided by AWS Truepower for site wind characteristics.
- Five (5) receptors which received a theoretical shadow flicker impact greater than 30 hours per year and 30 minutes per day. The following receptors are those that exceeded this yield and used in the real case model:
 - SR1, SR2,SR3, SR14, SR15
- Five (5) receptors which received a theoretical shadow impact greater than 30 minutes per day. The following receptors are those that exceeded this yield and used in the real case model:
 - SR7, SR9, SR10, SR10A, SR11
- Publically available data for Average Percentage of Possible Sunshine from the National Oceanic and Atmospheric Administration, National Climatic Data Center (www.ncdc.noaa.gov)
 - Average Percentage of Possible Sunshine - the total time that sunshine reaches the surface of the earth is expressed as the percentage of the maximum amount possible from sunrise to sunset with clear sky conditions¹.
 - Monthly average percent possible sunshine data over a span of 113 years (1896-2009) from the Blue Hill Observatory in Milton, MA².

Based off of the Average Percentage of Possible Sunshine data (APPS) from the Blue Hill Observatory, which is located approximately 98 miles to the east of the proposed turbine for the Town of Otis and shown in Figure 2, SED was able to determine the Average Daily Sunshine Probabilities (ADSP) per month to input into WindPRO. These calculations are shown as Figure 3. WindPRO then uses the ADSP inputs as a percentage of the potential monthly sun hours to adjust the theoretical case scenario results.

¹ <http://ols.nndc.noaa.gov/plolstore/plsql/olstore.prodspcific?prodnum=C00095-PUB-A0001>

² Location was selected in consultation with Town of Charlton's third-party reviewer, VHB.

Figure 2:

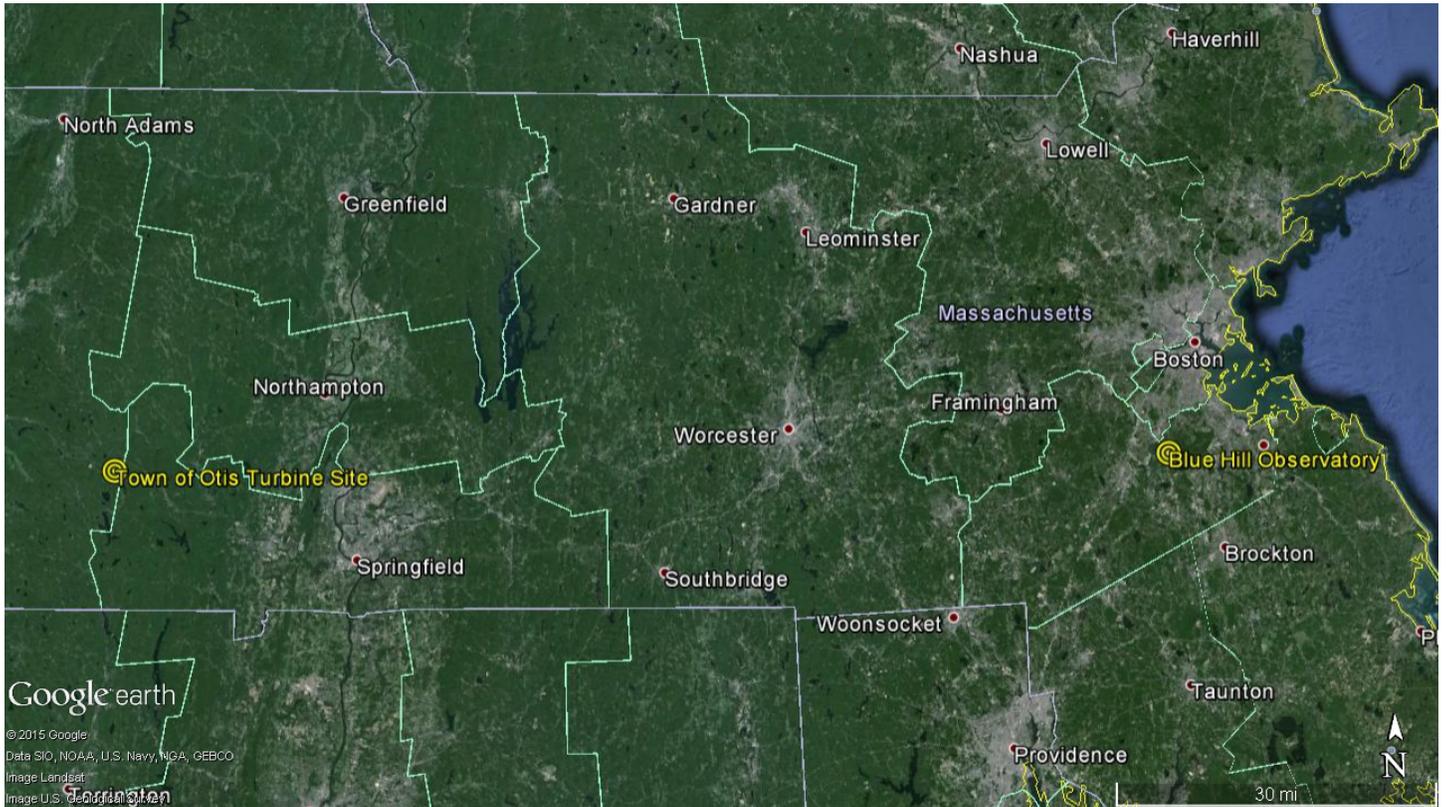


Figure 3:

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Potential Monthly Sun Hours	294	296	370	400	451	456	463	430	375	344	295	284
Potential Daily Sun Hours	9.48	10.57	11.94	13.33	14.55	15.20	14.94	13.87	12.50	11.10	9.83	9.16
Blue Hill APPS	46%	50%	58%	59%	52%	55%	57%	58%	56%	55%	47%	46%
ADSP Hours	4.36	5.29	6.92	7.87	7.57	8.36	8.51	8.05	7.00	6.10	4.62	4.21

Long term correlated data from the 80m Virtual Met Mast was also used to determine the wind distribution and operating time for the proposed wind turbines. This gives the model the probable hours of operation for

each wind-direction sector. Once the above data was entered into WindPRO and real case shadow flicker model was ran, the following flicker impacts resulted at the identified receptors:

Figure 4:

Receptor	Shadow Flicker Hours Per Year: Real Case (hh:mm)
SR1	26:11
SR2	10:55
SR3	11:25
SR7	6:50
SR9	7:09
SR10A	6:19
SR10	6:29
SR11	9:24
SR14	17:10
SR15	11:02

The WindPRO report is attached and includes the main report outlining the results.

The results in the attached shadow flicker model should be considered conservative, as they do not account for any obstructions between the turbine site and receptor location, such as trees. It should be considered that the area encompassing the turbine site and receptor locations is heavily forested. Any shading caused by these obstructions, in direct line of sight between the turbine site and receptor location, will further reduce the shadow flicker effect at these receptors.

Project: Description:
Otis Real Case Shadow Flicker Assessment for Town of Otis - Algeria Rd. Site
 GE 1.7 103m Rotor 80m Hub
 Real Case Statistics:
 Average Percent of Possible Sunshine (APPS) Obtained from NOAA - National Climatic Data Center (www.ncdc.noaa.gov)
 APPS Gathered at Blue Hill Observatory in Milton, MA (Data Span 1896-2009)

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SED, Inc.
 317 State Route 104
 US-14519 Ontario, NY
 4738
 Scott Abbett / scott.abbett@sed-net.com
 Calculated:
 9/3/2015 1:59 PM/2.7.486

SHADOW - Main Result

Calculation: Otis Shadow Flicker - Algeria Rd. REAL CASE

Assumptions for shadow calculations

Maximum distance for influence
 Calculate only when more than 20 % of sun is covered by the blade
 Please look in WTG table

Minimum sun height over horizon for influence 3 °
 Day step for calculation 1 days
 Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) []
 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
 4.36 5.29 6.92 7.87 7.57 8.36 8.51 8.05 7.00 6.10 4.62 4.21

Operational hours are calculated from WTGs in calculation and wind distribution:
 WS Met Mast VMM Alternate Site

Operational time
 N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum
 442 226 352 623 302 199 233 473 992 1,070 1,285 2,170 8,367
 Idle start wind speed: Cut in wind speed from power curve

A ZVI (Zones of Visual Influence) calculation is performed before flicker calculation so non visible WTG do not contribute to calculated flicker values. A WTG will be visible if it is visible from any part of the receiver window. The ZVI calculation is based on the following assumptions:

Height contours used: DEM
 Obstacles used in calculation
 Eye height: 1.5 m
 Grid resolution: 10 m



Scale 1:7,500
 New WTG Shadow receptor

WTGs

UTM WGS84 Zone: 18				WTG type			Shadow data				
East	North	Z	Row data/Description	Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Calculation distance [m]	RPM [RPM]
662,915	4,676,722	499.3	GE 1.7 103m Rotor 80m Hub	Yes	GE WIND ENERGY	GE 1.7-1,700	1,700	103.0	80.0	2,000	0.0

Shadow receptor-Input

UTM WGS84 Zone: 18										
No.	Name	East	North	Z	Width [m]	Height [m]	Height a.g.l. [m]	Degrees from south cw [°]	Slope of window [°]	Direction mode
A	SR1	662,753	4,676,952	517.1	1.0	1.0	1.5	-180.0	90.0	"Green house mode"
B	SR3	662,356	4,677,065	486.4	1.0	1.0	1.5	-180.0	90.0	"Green house mode"
C	SR2	662,371	4,676,988	484.3	1.0	1.0	1.5	-180.0	90.0	"Green house mode"
D	SR7	662,180	4,676,810	480.0	1.0	1.0	1.5	-180.0	90.0	"Green house mode"
E	SR9	662,189	4,676,757	480.0	1.0	1.0	1.5	-180.0	90.0	"Green house mode"
F	SR10A	662,124	4,676,664	480.0	1.0	1.0	1.5	-180.0	90.0	"Green house mode"
G	SR10	662,125	4,676,620	480.0	1.0	1.0	1.5	-180.0	90.0	"Green house mode"
H	SR11	662,242	4,676,603	480.0	1.0	1.0	1.5	-180.0	90.0	"Green house mode"
I	SR14	662,279	4,676,466	479.9	1.0	1.0	1.5	-180.0	90.0	"Green house mode"
J	SR15	662,168	4,676,430	477.6	1.0	1.0	1.5	-180.0	90.0	"Green house mode"

Calculation Results

Shadow receptor

Shadow, expected values	
No.	Name
A	SR1
B	SR3
C	SR2
D	SR7
E	SR9
F	SR10A
G	SR10
H	SR11
I	SR14
J	SR15

Total amount of flickering on the shadow receptors caused by each WTG

No.	Name	Worst case [h/year]	Expected [h/year]
1	GE 1.7 103m Rotor 80m Hub	263:19	88:57

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SHADOW - Calendar

Calculation: Otis Shadow Flicker - Algeria Rd. REAL CASE Shadow receptor: A - SR1

Assumptions for shadow calculations

Maximum distance for influence 2,000 m
 Minimum sun height over horizon for influence 3 °
 Day step for calculation 1 days
 Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) []
 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
 4.36 5.29 6.92 7.87 7.57 8.36 8.51 8.05 7.00 6.10 4.62 4.21

Operational time
 N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum
 442 226 352 623 302 199 233 473 992 1,070 1,285 2,170 8,367
 Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December	
1	07:22 16:31 82	08:42 (1) 07:07 10:04 (1) 17:06	06:29 17:42	06:37 19:18	05:49 19:51	05:19 20:21	05:20 20:33	05:45 20:14	06:17 19:28	06:49 18:35	06:25 16:47	07:01 16:22 75	08:31 (1) 09:46 (1)
2	07:22 16:32 82	08:42 (1) 07:06 10:04 (1) 17:07	06:28 17:43	06:35 19:19	05:48 19:52	05:19 20:22	05:20 20:33	05:46 20:13	06:18 19:26	06:50 18:34	06:26 16:46	07:02 16:21 76	08:31 (1) 09:47 (1)
3	07:22 16:32 81	08:43 (1) 07:05 10:04 (1) 17:09	06:26 17:44	06:33 19:20	05:46 19:53	05:18 20:23	05:21 20:33	05:47 20:12	06:19 19:24	06:51 18:32	06:27 16:45	07:03 16:21 76	08:31 (1) 09:47 (1)
4	07:22 16:33 80	08:44 (1) 07:04 10:04 (1) 17:10	06:24 17:45	06:31 19:21	05:45 19:54	05:18 20:23	05:21 20:33	05:48 20:10	06:20 19:23	06:52 18:30	06:29 16:43	07:04 16:21 77	08:31 (1) 09:48 (1)
5	07:22 16:34 80	08:44 (1) 07:02 10:04 (1) 17:11	06:23 17:47	06:30 19:22	05:44 19:56	05:17 20:24	05:22 20:32	05:49 20:09	06:21 19:21	06:53 18:29	06:30 16:42	07:05 16:21 78	08:31 (1) 09:49 (1)
6	07:22 16:35 79	08:45 (1) 07:01 10:04 (1) 17:13	06:21 17:48	06:28 19:23	05:43 19:57	05:17 20:25	05:22 20:32	05:50 20:08	06:22 19:19	06:54 18:27	06:31 16:41	07:06 16:21 79	08:31 (1) 09:50 (1)
7	07:22 16:36 79	08:45 (1) 07:00 10:04 (1) 17:14	06:19 17:49	06:26 19:24	05:41 19:58	05:17 20:26	05:23 20:32	05:51 20:07	06:23 19:18	06:55 18:25	06:32 16:40	07:07 16:20 80	08:31 (1) 09:51 (1)
8	07:21 16:37 78	08:46 (1) 06:59 10:04 (1) 17:15	07:18 18:50	06:25 19:25	05:40 19:59	05:17 20:26	05:24 20:32	05:52 20:05	06:24 19:16	06:57 18:24	06:34 16:39	07:08 16:20 80	08:31 (1) 09:51 (1)
9	07:21 16:38 76	08:48 (1) 06:58 10:04 (1) 17:17	07:16 18:51	06:23 19:27	05:39 20:00	05:16 20:27	05:24 20:31	05:53 20:04	06:25 19:14	06:58 18:22	06:35 16:38	07:09 16:20 81	08:31 (1) 09:52 (1)
10	07:21 16:39 76	08:48 (1) 06:57 10:04 (1) 17:18	07:14 18:53	06:21 19:28	05:38 20:00	05:16 20:27	05:25 20:31	05:54 20:03	06:27 19:12	06:59 18:20	06:36 16:37	07:10 16:20 81	08:32 (1) 09:53 (1)
11	07:21 16:40 75	08:49 (1) 06:55 10:04 (1) 17:19	07:13 18:54	06:20 19:29	05:37 20:01	05:16 20:28	05:26 20:30	05:55 20:01	06:28 19:11	07:00 18:19	06:37 16:36	07:11 16:20 82	08:32 (1) 09:54 (1)
12	07:20 16:42 74	08:50 (1) 06:54 10:04 (1) 17:20	07:11 18:55	06:18 19:30	05:36 20:02	05:16 20:29	05:27 20:30	05:56 20:00	06:29 19:09	07:01 18:17	06:38 16:35	08:52 (1) 07:12 09:10 (1) 16:21	08:32 (1) 09:55 (1)
13	07:20 16:43 73	08:50 (1) 06:53 10:03 (1) 17:22	07:09 18:56	06:16 19:31	05:34 20:03	05:16 20:29	05:27 20:29	05:57 19:57	06:30 19:07	07:02 18:15	06:40 16:34	08:48 (1) 07:12 09:15 (1) 16:21	08:32 (1) 09:54 (1)
14	07:20 16:44 71	08:52 (1) 06:51 10:03 (1) 17:23	07:08 18:57	06:15 19:32	05:33 20:04	05:16 20:30	05:28 20:29	05:58 19:56	06:31 19:05	07:03 18:14	06:41 16:33	08:45 (1) 07:13 09:18 (1) 16:21	08:32 (1) 09:55 (1)
15	07:19 16:45 70	08:52 (1) 06:50 10:02 (1) 17:24	07:06 18:58	06:13 19:33	05:32 20:05	05:16 20:30	05:29 20:28	05:59 19:55	06:32 19:04	07:04 18:12	06:42 16:32	08:42 (1) 07:14 09:21 (1) 16:21	08:33 (1) 09:56 (1)
16	07:19 16:46 68	08:54 (1) 06:49 10:02 (1) 17:26	07:04 19:00	06:12 19:34	05:31 20:06	05:16 20:30	05:30 20:28	06:00 19:53	06:33 19:02	07:06 18:10	06:43 16:31	08:41 (1) 07:15 09:24 (1) 16:21	08:34 (1) 09:57 (1)
17	07:18 16:47 67	08:54 (1) 06:47 10:01 (1) 17:27	07:02 19:01	06:10 19:36	05:30 20:07	05:16 20:31	05:31 20:27	06:01 19:52	06:34 19:00	07:07 18:09	06:45 16:30	08:39 (1) 07:15 09:26 (1) 16:22	08:33 (1) 09:57 (1)
18	07:18 16:49 65	08:56 (1) 06:46 10:01 (1) 17:28	07:01 19:02	06:08 19:37	05:29 20:08	05:16 20:31	05:31 20:26	06:02 19:50	06:35 18:58	07:08 18:07	06:46 16:29	08:38 (1) 07:16 09:28 (1) 16:22	08:34 (1) 09:58 (1)
19	07:17 16:50 63	08:57 (1) 06:44 10:00 (1) 17:29	06:59 19:03	06:07 19:38	05:28 20:09	05:16 20:32	05:32 20:26	06:03 19:49	06:36 18:57	07:09 18:06	06:47 16:28	08:36 (1) 07:17 09:30 (1) 16:22	08:35 (1) 09:59 (1)
20	07:17 16:51 61	08:58 (1) 06:43 09:59 (1) 17:31	06:57 19:04	06:05 19:39	05:28 20:10	05:16 20:32	05:33 20:25	06:04 19:47	06:37 18:55	07:10 18:04	06:48 16:28	08:36 (1) 07:17 09:32 (1) 16:23	08:35 (1) 09:59 (1)
21	07:16 16:52 59	08:59 (1) 06:41 09:58 (1) 17:32	06:56 19:05	06:04 19:40	05:27 20:11	05:16 20:32	05:34 20:24	06:06 19:46	06:38 18:53	07:11 18:03	06:50 16:27	08:35 (1) 07:18 09:34 (1) 16:23	08:36 (1) 10:00 (1)
22	07:15 16:53 56	09:01 (1) 06:40 09:57 (1) 17:33	06:54 19:06	06:02 19:41	05:26 20:12	05:16 20:32	05:35 20:23	06:07 19:44	06:39 18:51	07:13 18:01	06:51 16:26	08:34 (1) 07:18 09:35 (1) 16:24	08:36 (1) 10:00 (1)
23	07:15 16:55 54	09:02 (1) 06:38 09:56 (1) 17:34	06:52 19:07	06:01 19:42	05:25 20:13	05:17 20:33	05:36 20:23	06:08 19:42	06:40 18:49	07:14 18:00	06:52 16:26	08:34 (1) 07:19 09:37 (1) 16:24	08:37 (1) 10:01 (1)
24	07:14 16:56 50	09:04 (1) 06:37 09:54 (1) 17:36	06:50 19:09	05:59 19:43	05:24 20:14	05:17 20:33	05:37 20:22	06:09 19:41	06:41 18:48	07:15 17:58	06:53 16:25	08:33 (1) 07:19 09:38 (1) 16:25	08:37 (1) 10:01 (1)
25	07:13 16:57 47	09:05 (1) 06:35 09:52 (1) 17:37	06:49 19:10	05:58 19:44	05:23 20:15	05:17 20:33	05:38 20:21	06:10 19:39	06:42 18:46	07:16 17:57	06:54 16:24	08:32 (1) 07:20 09:39 (1) 16:25	08:37 (1) 10:01 (1)
26	07:12 16:58 43	09:07 (1) 06:34 09:50 (1) 17:38	06:47 19:11	05:56 19:46	05:23 20:16	05:17 20:33	05:39 20:20	06:11 19:38	06:43 18:44	07:17 17:55	06:55 16:24	08:32 (1) 07:20 09:40 (1) 16:26	08:38 (1) 10:02 (1)
27	07:11 17:00 38	09:11 (1) 06:32 09:49 (1) 17:39	06:45 19:12	05:55 19:47	05:22 20:17	05:18 20:33	05:40 20:19	06:12 19:36	06:44 18:42	07:19 17:54	06:57 16:23	08:31 (1) 07:20 09:41 (1) 16:27	08:38 (1) 10:02 (1)
28	07:11 17:01 33	09:13 (1) 06:31 09:46 (1) 17:41	06:43 19:13	05:53 19:48	05:21 20:18	05:18 20:33	05:41 20:18	06:13 19:34	06:46 18:41	07:20 17:53	06:58 16:23	08:32 (1) 07:21 09:43 (1) 16:27	08:39 (1) 10:02 (1)
29	07:10 17:02 27	09:16 (1) 09:43 (1)	06:42 19:14	05:52 19:49	05:21 20:19	05:19 20:33	05:42 20:17	06:14 19:33	06:47 18:39	07:21 17:51	06:59 16:22	08:31 (1) 07:21 09:44 (1) 16:28	08:39 (1) 10:02 (1)
30	07:09 17:04 17	09:21 (1) 09:38 (1)	06:40 19:15	05:51 19:50	05:20 20:19	05:19 20:33	05:43 20:16	06:15 19:31	06:48 18:37	07:22 17:50	07:00 16:22	08:31 (1) 07:21 09:45 (1) 16:29	08:40 (1) 10:02 (1)
31	07:08 17:05	06:38 19:16	05:20 20:20	05:44 20:15	06:16 19:29	07:24 17:48	07:21 16:30	07:21 16:30	07:21 16:30	07:21 16:30	07:21 16:30	07:21 16:30	08:41 (1) 10:04 (1)
Potential sun hours	294	296	370	401	451	456	463	430	375	344	295	284	
Total, worst case	1904										1038	2534	
Sun reduction	0.46										0.47	0.46	
Oper. time red.	0.96										0.96	0.96	
Wind dir. red.	0.65										0.65	0.65	
Total reduction	0.29										0.29	0.29	
Total, real	544										303	724	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)		Last time (hh:mm) with flicker	(WTG causing flicker last time)

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SHADOW - Calendar

Calculation: Otis Shadow Flicker - Algeria Rd. REAL CASE Shadow receptor: B - SR3

Assumptions for shadow calculations

Maximum distance for influence 2,000 m
 Minimum sun height over horizon for influence 3 °
 Day step for calculation 1 days
 Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) []
 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
 4.36 5.29 6.92 7.87 7.57 8.36 8.51 8.05 7.00 6.10 4.62 4.21

Operational time
 N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum
 442 226 352 623 302 199 233 473 992 1,070 1,285 2,170 8,367
 Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December	
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2	07:22 16:32	07:06 17:07	07:42 (1) 08:19 (1)	06:28 17:43	06:35 19:19	05:48 20:22	05:19 20:33	05:20 20:13	05:46 19:26	06:18 18:34	06:50 16:46	07:02 16:21	07:30 (1) 15 07:45 (1)
3	07:22 16:32	07:05 17:09	07:43 (1) 08:19 (1)	06:26 17:44	06:33 19:20	05:47 20:23	05:18 20:33	05:21 20:12	05:47 19:24	06:19 18:32	06:51 16:45	07:03 16:21	07:32 (1) 12 07:44 (1)
4	07:22 16:33	07:04 17:10	07:44 (1) 08:19 (1)	06:24 17:45	06:31 19:21	05:45 20:23	05:18 20:33	05:21 20:10	05:48 19:23	06:20 18:30	06:52 16:43	07:04 16:21	07:34 (1) 8 07:42 (1)
5	07:22 16:34	07:03 17:11	07:45 (1) 08:18 (1)	06:23 17:47	06:30 19:22	05:44 20:24	05:17 20:32	05:22 20:09	05:49 19:21	06:21 18:29	06:53 16:42	07:05 16:21	
6	07:22 16:35	07:01 17:13	07:46 (1) 08:18 (1)	06:21 17:48	06:28 19:23	05:43 20:25	05:17 20:32	05:50 20:08	06:22 19:19	06:54 18:27	07:06 16:41	07:06 16:21	
7	07:22 16:36	07:00 17:14	07:47 (1) 08:18 (1)	06:19 17:49	06:26 19:24	05:41 20:26	05:17 20:32	05:51 20:07	06:23 19:18	06:55 18:25	07:07 16:40	07:07 16:20	
8	07:21 16:37	07:50 (1) 07:58 (1)	06:59 17:15	07:47 (1) 08:16 (1)	07:18 18:50	06:25 19:25	05:17 20:26	05:24 20:05	05:52 19:16	06:24 18:24	06:57 16:39	07:08 16:20	
9	07:21 16:38	07:49 (1) 08:01 (1)	06:58 17:17	07:49 (1) 08:15 (1)	07:16 18:51	06:23 19:27	05:16 20:27	05:24 20:04	05:53 19:14	06:26 18:22	06:58 16:38	07:09 16:20	
10	07:21 16:39	07:47 (1) 08:02 (1)	06:57 17:18	07:50 (1) 08:14 (1)	07:14 18:53	06:21 19:28	05:16 20:27	05:25 20:03	06:27 19:12	06:59 18:20	07:10 16:37	07:10 16:20	
11	07:21 16:40	07:46 (1) 08:04 (1)	06:55 17:19	07:53 (1) 08:12 (1)	07:13 18:54	06:20 19:29	05:16 20:28	05:26 20:02	06:28 19:11	07:00 18:19	07:11 16:36	07:11 16:20	
12	07:20 16:42	07:46 (1) 08:06 (1)	06:54 17:20	07:54 (1) 08:09 (1)	07:11 18:55	06:18 20:02	05:16 20:29	05:27 20:00	06:29 19:09	07:01 18:17	07:12 16:35	07:12 16:21	
13	07:20 16:43	07:45 (1) 08:07 (1)	06:53 17:22	08:00 (1) 08:03 (1)	07:09 18:56	06:16 19:31	05:16 20:29	05:27 20:29	06:30 19:07	07:02 18:15	07:12 16:34	07:12 16:21	
14	07:20 16:44	07:45 (1) 08:09 (1)	06:51 17:23	07:08 18:57	06:15 19:32	05:33 20:04	05:16 20:29	05:28 19:56	06:31 19:05	07:03 18:14	07:13 16:33	07:13 16:21	
15	07:19 16:45	07:44 (1) 08:09 (1)	06:50 17:24	07:06 18:58	06:13 19:33	05:32 20:05	05:16 20:30	05:29 19:55	06:32 19:04	07:04 18:12	07:14 16:32	07:14 16:21	
16	07:19 16:46	07:44 (1) 08:11 (1)	06:49 17:26	07:04 19:00	06:12 19:34	05:31 20:06	05:16 20:30	06:00 19:53	06:33 19:02	07:06 18:10	07:15 16:31	07:15 16:21	
17	07:18 16:47	07:43 (1) 08:12 (1)	06:47 17:27	07:03 19:01	06:10 19:36	05:30 20:07	05:16 20:31	06:01 20:27	06:34 19:52	07:07 18:09	07:15 16:30	07:15 16:22	
18	07:18 16:49	07:43 (1) 08:13 (1)	06:46 17:28	07:01 19:02	06:08 19:37	05:29 20:08	05:16 20:31	06:02 20:26	06:35 19:50	07:08 18:07	07:16 16:29	07:16 16:22	
19	07:17 16:50	07:42 (1) 08:14 (1)	06:44 17:29	06:59 19:03	06:07 19:38	05:28 20:09	05:16 20:32	06:03 19:49	06:36 18:57	07:09 18:06	07:17 16:28	07:17 16:22	
20	07:17 16:51	07:42 (1) 08:15 (1)	06:43 17:31	06:57 19:04	06:05 19:39	05:28 20:10	05:16 20:32	06:04 19:47	06:37 18:55	07:10 18:04	07:17 16:28	07:17 16:23	
21	07:16 16:52	07:42 (1) 08:16 (1)	06:41 17:32	06:56 19:05	06:04 19:40	05:27 20:11	05:16 20:32	06:06 19:46	06:38 18:53	07:11 18:03	07:18 16:27	07:18 16:23	
22	07:15 16:53	07:42 (1) 08:17 (1)	06:40 17:33	06:54 19:06	06:02 19:41	05:26 20:12	05:16 20:32	06:07 19:44	06:39 18:51	07:13 18:01	07:18 16:26	07:18 16:24	
23	07:15 16:55	07:41 (1) 08:17 (1)	06:39 17:34	06:52 19:08	06:01 19:42	05:25 20:13	05:17 20:33	06:08 19:42	06:40 18:49	07:14 18:00	07:19 16:26	07:19 16:24	
24	07:14 16:56	07:41 (1) 08:17 (1)	06:37 17:36	06:50 19:09	05:59 19:43	05:24 20:14	05:17 20:33	06:09 19:41	06:41 18:48	07:15 17:58	07:20 16:25	07:20 16:25	
25	07:13 16:57	07:41 (1) 08:18 (1)	06:35 17:37	06:49 19:10	05:58 19:44	05:23 20:15	05:17 20:33	06:10 20:21	06:42 19:39	07:16 18:46	07:21 16:24	07:21 16:25	
26	07:12 16:58	07:41 (1) 08:18 (1)	06:34 17:38	06:47 19:11	05:56 19:46	05:23 20:16	05:17 20:33	06:11 20:20	06:43 19:38	07:17 17:55	07:20 16:24	07:20 16:26	
27	07:11 17:00	07:42 (1) 08:19 (1)	06:32 17:39	06:45 19:12	05:55 19:47	05:22 20:17	05:18 20:33	06:12 20:19	06:44 19:36	07:19 18:42	07:20 16:23	07:20 16:27	
28	07:11 17:01	07:42 (1) 08:20 (1)	06:31 17:41	06:43 19:13	05:53 19:48	05:21 20:18	05:18 20:33	06:13 19:34	06:46 18:41	07:20 17:53	07:21 16:23	07:21 16:27	
29	07:10 17:02	07:42 (1) 08:20 (1)	06:41 17:41	06:42 19:14	05:52 19:49	05:19 20:19	05:19 20:33	06:14 20:17	06:47 19:33	07:21 17:51	07:21 16:22	07:21 16:28	
30	07:09 17:04	07:42 (1) 08:20 (1)	06:31 17:41	06:40 19:15	05:51 19:50	05:20 20:20	05:19 20:33	06:15 19:31	06:48 18:37	07:22 17:50	07:22 16:22	07:22 16:29	
31	07:08 17:05	07:43 (1) 08:20 (1)	06:31 17:41	06:38 19:17	05:50 20:20	05:20 20:20	05:19 20:15	06:16 19:29	06:21 17:48	07:24 08:41 (1)	07:24 16:20	07:24 16:30	
Potential sun hours	294	296	370	401	451	456	463	430	375	344	295	284	
Total, worst case	698	357								42	970	53	
Sun reduction	0.46	0.50								0.55	0.47	0.46	
Oper. time red.	0.96	0.96								0.96	0.96	0.96	
Wind dir. red.	0.72	0.72								0.72	0.72	0.72	
Total reduction	0.31	0.34								0.38	0.32	0.31	
Total, real	219	122								16	312	17	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)		Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project: **Otis** Description: Real Case Shadow Flicker Assessment for Town of Otis - Algeria Rd. Site
 GE 1.7 103m Rotor 80m Hub
 Real Case Statistics:
 Average Percent of Possible Sunshine (APPS) Obtained from NOAA - National Climatic Data Center (www.ncdc.noaa.gov)
 APPS Gathered at Blue Hill Observatory in Milton, MA (Data Span 1896-2009)

Printed/Page: 9/4/2015 11:06 AM / 4
 Licensed user: **SED, Inc.**
 317 State Route 104
 US-14519 Ontario, NY
 4738
 Scott Abbett / scott.abbett@sed-net.com
 Calculated: 9/3/2015 1:59 PM/2.7.486

SHADOW - Calendar

Calculation: Otis Shadow Flicker - Algeria Rd. REAL CASE Shadow receptor: C - SR2

Assumptions for shadow calculations

Maximum distance for influence 2,000 m
 Minimum sun height over horizon for influence 3 °
 Day step for calculation 1 days
 Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) []
 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
 4.36 5.29 6.92 7.87 7.57 8.36 8.51 8.05 7.00 6.10 4.62 4.21

Operational time
 N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum
 442 226 352 623 302 199 233 473 992 1,070 1,285 2,170 8,367
 Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December		
1	07:22 16:31	07:07 17:06	07:33 (1) 08:01 (1)	06:29 17:42	06:37 19:18	05:49 19:51	05:19 20:21	05:20 20:33	05:45 20:14	06:17 19:28	06:49 18:35	06:25 16:47	06:58 (1) 07:37 (1)	07:01 16:22
2	07:22 16:32	07:06 17:07	07:31 (1) 08:01 (1)	06:28 17:43	06:35 19:19	05:48 19:52	05:19 20:22	05:20 20:33	05:46 20:13	06:18 19:26	06:50 18:34	06:26 16:46	06:58 (1) 07:37 (1)	07:02 16:21
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4	07:22 16:33	07:04 17:10	07:30 (1) 08:04 (1)	06:24 17:45	06:31 19:21	05:45 19:54	05:18 20:23	05:21 20:33	05:48 20:10	06:20 19:23	06:52 18:30	06:29 16:43	06:59 (1) 07:36 (1)	07:04 16:21
5	07:22 16:34	07:03 17:11	07:30 (1) 08:05 (1)	06:23 17:47	06:30 19:22	05:44 19:56	05:17 20:24	05:22 20:32	05:49 20:09	06:21 19:21	06:53 18:29	06:30 16:42	06:59 (1) 07:35 (1)	07:05 16:21
6	07:22 16:35	07:01 17:13	07:29 (1) 08:06 (1)	06:21 17:48	06:28 19:23	05:43 19:57	05:17 20:25	05:22 20:32	05:50 20:08	06:22 19:19	06:54 18:27	06:31 16:41	06:59 (1) 07:34 (1)	07:06 16:21
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8	07:21 16:37	06:59 17:15	07:28 (1) 08:06 (1)	07:18 18:50	06:25 19:25	05:40 19:59	05:17 20:26	05:24 20:32	05:52 20:05	06:24 19:16	06:57 18:24	06:34 16:39	07:02 (1) 07:33 (1)	07:08 16:20
9	07:21 16:38	06:58 17:17	07:28 (1) 08:07 (1)	07:16 18:51	06:23 19:27	05:39 20:00	05:16 20:27	05:24 20:31	05:53 20:03	06:26 19:12	06:58 18:20	06:35 16:37	07:02 (1) 07:34 (1)	07:09 16:20
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11	07:21 16:40	06:55 17:19	07:28 (1) 08:08 (1)	07:13 18:54	06:20 19:29	05:37 20:01	05:16 20:28	05:26 20:30	05:55 20:02	06:28 19:11	07:00 18:19	06:37 16:36	07:05 (1) 07:30 (1)	07:11 16:20
12	07:20 16:42	06:54 17:20	07:27 (1) 08:07 (1)	07:11 18:55	06:18 19:30	05:36 20:02	05:16 20:29	05:27 20:30	05:56 20:00	06:29 19:09	07:01 18:17	06:39 16:35	07:07 (1) 07:28 (1)	07:12 16:21
13	07:20 16:43	06:53 17:22	07:28 (1) 08:08 (1)	07:09 18:56	06:16 19:31	05:34 20:03	05:16 20:29	05:27 20:29	05:57 19:57	06:30 19:07	07:02 18:15	06:40 16:34	07:10 (1) 07:27 (1)	07:12 16:21
14	07:20 16:44	06:51 17:23	07:28 (1) 08:08 (1)	07:08 18:57	06:15 19:32	05:33 20:04	05:16 20:30	05:28 20:29	05:58 19:56	06:31 19:05	07:03 18:14	06:41 16:33	07:12 (1) 07:24 (1)	07:13 16:21
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16	07:19 16:46	06:49 17:26	07:29 (1) 08:07 (1)	07:04 19:00	06:12 19:34	05:31 20:06	05:16 20:30	06:00 20:28	06:33 19:53	07:06 19:02	07:06 18:10	06:43 16:31	07:15 (1) 08:09 (1)	07:15 16:21
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18	07:18 16:49	06:46 17:28	07:29 (1) 08:06 (1)	07:01 19:02	06:08 19:37	05:29 20:08	05:16 20:31	06:02 20:26	06:35 19:50	07:08 18:58	07:08 18:07	06:46 16:29	07:16 (1) 08:29 (1)	07:16 16:22
19	07:17 16:50	06:44 17:29	07:30 (1) 08:04 (1)	06:59 19:03	06:07 19:38	05:28 20:09	05:16 20:32	06:03 20:26	06:36 19:49	07:09 18:57	07:09 18:06	06:47 16:28	07:17 (1) 08:31 (1)	07:17 16:22
20	07:17 16:51	06:43 17:31	07:31 (1) 08:04 (1)	06:57 19:04	06:05 19:39	05:28 20:10	05:16 20:32	06:04 19:47	06:37 18:55	07:10 18:04	07:10 17:55	06:48 16:28	07:18 (1) 08:32 (1)	07:17 16:23
21	07:16 16:52	06:41 17:32	07:31 (1) 08:02 (1)	06:56 19:05	06:04 19:40	05:27 20:11	05:16 20:32	06:06 20:24	06:38 18:53	07:11 18:03	07:11 17:53	06:50 16:27	07:18 (1) 08:33 (1)	07:18 16:23
22	07:15 16:53	06:40 17:33	07:33 (1) 08:01 (1)	06:54 19:06	06:02 19:41	05:26 20:12	05:16 20:32	06:07 20:23	06:39 19:44	07:13 18:51	07:13 18:01	06:51 16:26	07:18 (1) 08:01 (1)	07:18 16:24
23	07:15 16:55	06:39 17:34	07:34 (1) 07:59 (1)	06:52 19:08	06:01 19:42	05:25 20:13	05:17 20:33	06:08 19:42	06:40 18:49	07:14 18:00	07:14 17:55	06:52 16:24	07:19 (1) 08:35 (1)	07:19 16:24
24	07:14 16:56	06:37 17:36	07:36 (1) 07:57 (1)	06:50 19:09	05:59 19:43	05:24 20:14	05:17 20:33	06:09 20:22	06:41 19:41	07:15 18:48	07:15 17:58	06:53 16:25	07:20 (1) 08:35 (1)	07:19 16:25
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26	07:12 16:58	06:34 17:38	06:47 19:11	06:47 19:46	05:56 20:16	05:23 20:33	05:17 20:20	06:11 19:38	06:43 18:44	07:17 17:55	07:17 16:24	06:55 16:24	07:22 (1) 08:37 (1)	07:20 16:26
27	07:11 17:00	06:32 17:39	06:45 19:12	06:45 19:47	05:55 20:17	05:22 20:33	05:18 20:19	06:12 19:36	06:44 18:42	07:19 17:54	07:19 16:23	06:57 16:23	07:23 (1) 08:37 (1)	07:20 16:27
28	07:11 17:01	06:31 07:40 (1)	06:43 19:13	06:43 19:48	05:53 20:18	05:21 20:33	05:18 20:18	06:13 19:34	06:46 18:41	07:20 17:53	07:20 16:23	06:58 16:23	07:24 (1) 08:37 (1)	07:21 16:27
29	07:10 17:02	06:30 07:38 (1)	06:42 19:14	06:42 19:49	05:52 20:19	05:21 20:33	05:19 20:17	06:14 19:33	06:47 18:39	07:21 17:51	07:21 16:22	06:59 16:22	07:25 (1) 08:37 (1)	07:21 16:28
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Potential sun hours	294	296	370	401	451	456	463	430	375	344	295	284		
Total, worst case	76	849									517	421		
Sun reduction	0.46	0.50									0.55	0.47		
Oper. time red.	0.96	0.96									0.96	0.96		
Wind dir. red.	0.73	0.73									0.73	0.73		
Total reduction	0.32	0.35									0.38	0.33		
Total, real	24	296									198	138		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)		Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project: **Otis** Description: Real Case Shadow Flicker Assessment for Town of Otis - Algerie Rd. Site
 GE 1.7 103m Rotor 80m Hub
 Real Case Statistics:
 Average Percent of Possible Sunshine (APPS) Obtained from NOAA - National Climatic Data Center (www.ncdc.noaa.gov)
 APPS Gathered at Blue Hill Observatory in Milton, MA (Data Span 1896-2009)

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 Licensed user: **SED, Inc.**
 317 State Route 104
 US-14519 Ontario, NY
 4738
 Scott Abbett / scott.abbett@sed-net.com
 Calculated: 9/3/2015 1:59 PM/2.7.486

SHADOW - Calendar

Calculation: Otis Shadow Flicker - Algerie Rd. REAL CASE Shadow receptor: D - SR7

Assumptions for shadow calculations

Maximum distance for influence 2,000 m
 Minimum sun height over horizon for influence 3 °
 Day step for calculation 1 days
 Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) []
 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
 4.36 5.29 6.92 7.87 7.57 8.36 8.51 8.05 7.00 6.10 4.62 4.21
 Operational time
 N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum
 442 226 352 623 302 199 233 473 992 1,070 1,285 2,170 8,367
 Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December	
1	07:22 16:31	07:07 17:06	06:29 17:42	06:37 19:18	05:49 19:51	05:19 20:21	05:20 20:33	05:45 20:14	06:17 19:28	06:49 18:36	07:12 (1) 07:39 (1)	06:25 16:47	07:01 16:22
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3	07:22 16:32	07:05 17:09	06:26 17:44	06:33 19:20	05:47 19:53	05:18 20:23	05:21 20:33	05:47 20:12	06:19 19:24	06:51 18:32	07:14 (1) 07:35 (1)	06:27 16:45	07:03 16:21
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5	07:22 16:34	07:03 17:11	06:23 17:47	06:30 19:22	05:44 19:56	05:17 20:24	05:22 20:32	05:49 20:09	06:21 19:21	06:53 18:29	07:18 (1) 07:29 (1)	06:30 16:42	07:05 16:21
6	07:22 16:35	07:01 17:13	06:21 17:48	06:28 19:23	05:43 19:57	05:17 20:25	05:22 20:32	05:50 20:08	06:22 19:19	06:54 18:27		06:31 16:41	07:06 16:21
7	07:22 16:36	07:00 17:14	06:19 17:49	06:26 19:24	05:41 19:58	05:17 20:26	05:23 20:32	05:51 20:05	06:23 19:16	06:55 18:24		06:32 16:39	07:07 16:20
8	07:21 16:37	06:59 17:15	07:18 18:50	07:44 (1) 07:49 (1)	06:25 19:25	05:40 19:59	05:17 20:26	05:24 20:32	06:24 19:16	06:57 18:24		06:34 16:39	07:08 16:20
9	07:21 16:38	06:58 17:17	07:16 18:51	07:40 (1) 07:55 (1)	06:23 19:27	05:39 20:00	05:16 20:27	05:24 20:31	06:26 19:14	06:58 18:22		06:35 16:38	07:09 16:20
10	07:21 16:39	06:57 17:18	07:14 18:53	07:37 (1) 07:56 (1)	06:21 19:28	05:38 20:00	05:16 20:27	05:25 20:31	06:27 19:12	06:59 18:20		06:36 16:37	07:10 16:20
11	07:21 16:40	06:55 17:19	07:13 18:54	07:35 (1) 07:58 (1)	06:20 19:29	05:37 20:01	05:16 20:28	05:26 20:30	06:28 19:11	07:00 18:19		06:37 16:36	07:11 16:20
12	07:20 16:42	06:54 17:20	07:11 18:55	07:34 (1) 07:59 (1)	06:18 19:30	05:36 20:02	05:16 20:29	05:27 20:30	06:29 19:09	07:01 18:17		06:39 16:35	07:12 16:21
13	07:20 16:43	06:53 17:22	07:09 18:56	07:32 (1) 08:00 (1)	06:16 19:31	05:34 20:03	05:16 20:29	05:27 20:29	06:30 19:07	07:02 18:15		06:40 16:34	07:12 16:21
14	07:20 16:44	06:51 17:23	07:08 18:57	07:31 (1) 08:00 (1)	06:15 19:32	05:33 20:04	05:16 20:30	05:28 20:29	06:31 19:05	07:03 18:14		06:41 16:33	07:13 16:21
15	07:19 16:45	06:50 17:24	07:06 18:58	07:30 (1) 08:00 (1)	06:13 19:33	05:32 20:05	05:16 20:30	05:29 20:28	06:32 19:04	07:04 18:12		06:42 16:32	07:14 16:21
16	07:19 16:46	06:49 17:26	07:04 19:00	07:30 (1) 08:01 (1)	06:12 19:34	05:31 20:06	05:16 20:30	05:30 20:28	06:00 19:53	07:24 (1) 07:37 (1)	07:06 18:10	06:43 16:31	07:15 16:21
17	07:18 16:47	06:47 17:27	07:03 19:01	07:29 (1) 08:01 (1)	06:10 19:36	05:30 20:07	05:16 20:31	05:31 20:27	06:01 19:52	07:21 (1) 07:39 (1)	07:07 18:09	06:45 16:30	07:15 16:22
18	07:18 16:49	06:46 17:28	07:01 19:02	07:28 (1) 08:00 (1)	06:08 19:37	05:29 20:08	05:16 20:31	05:31 20:26	06:02 19:50	07:18 (1) 07:41 (1)	07:08 18:07	06:46 16:29	07:16 16:22
19	07:17 16:50	06:44 17:29	06:59 19:03	07:28 (1) 08:00 (1)	06:07 19:38	05:28 20:09	05:16 20:32	05:32 20:26	06:03 19:49	07:17 (1) 07:42 (1)	07:09 18:06	06:47 16:28	07:17 16:22
20	07:17 16:51	06:43 17:31	06:57 19:04	07:28 (1) 08:00 (1)	06:05 19:39	05:28 20:10	05:16 20:32	05:33 20:25	06:04 19:47	07:15 (1) 07:42 (1)	07:10 18:04	06:48 16:28	07:17 16:23
21	07:16 16:52	06:41 17:32	06:56 19:05	07:28 (1) 07:59 (1)	06:04 19:40	05:27 20:11	05:16 20:32	05:34 20:24	06:06 19:46	07:14 (1) 07:43 (1)	07:11 18:03	06:50 16:27	07:18 16:23
22	07:15 16:53	06:40 17:33	06:54 19:06	07:28 (1) 07:58 (1)	06:02 19:41	05:26 20:12	05:16 20:32	06:07 20:23	06:39 19:44	07:13 (1) 07:43 (1)	07:13 18:01	06:51 16:26	07:18 16:24
23	07:15 16:55	06:39 17:34	06:52 19:08	07:29 (1) 07:56 (1)	06:01 19:42	05:25 20:13	05:17 20:33	05:36 20:23	06:08 19:42	07:12 (1) 07:43 (1)	07:14 18:00	06:52 16:26	07:19 16:24
24	07:14 16:56	06:37 17:36	06:50 19:09	07:30 (1) 07:55 (1)	05:59 19:43	05:24 20:14	05:17 20:33	05:37 20:22	06:09 19:41	07:12 (1) 07:44 (1)	07:15 17:58	06:53 16:25	07:19 16:25
25	07:13 16:57	06:35 17:37	06:49 19:10	07:31 (1) 07:54 (1)	05:58 19:45	05:24 20:15	05:17 20:33	05:38 20:21	06:10 19:39	07:12 (1) 07:44 (1)	07:16 17:57	06:54 16:24	07:20 16:25
26	07:12 16:58	06:34 17:38	06:47 19:11	07:32 (1) 07:51 (1)	05:56 19:46	05:23 20:16	05:18 20:33	05:39 20:20	06:11 19:38	07:11 (1) 07:43 (1)	07:17 17:55	06:55 16:24	07:20 16:26
27	07:11 17:00	06:32 17:39	06:45 19:12	07:34 (1) 07:48 (1)	05:55 19:47	05:22 20:17	05:18 20:33	05:40 20:19	06:12 19:36	07:11 (1) 07:43 (1)	07:19 17:54	06:57 16:23	07:20 16:27
28	07:11 17:01	06:31 17:41	06:43 19:13	07:38 (1) 07:44 (1)	05:53 19:48	05:21 20:18	05:18 20:33	05:41 20:18	06:13 19:34	07:11 (1) 07:42 (1)	07:20 17:53	06:58 16:23	07:21 16:27
29	07:10 17:02		06:42 19:14		05:52 19:49	05:21 20:19	05:19 20:33	05:42 20:17	06:14 19:33	07:11 (1) 07:41 (1)	07:21 17:51	06:59 16:22	07:21 16:28
30	07:09 17:04		06:40 19:15		05:51 19:50	05:20 20:20	05:19 20:33	05:43 20:16	06:15 19:31	07:11 (1) 07:40 (1)	07:22 17:50	07:00 16:22	07:21 16:29
31	07:08 17:05		06:38 19:17		05:20 20:20		05:44 20:15	06:16 19:29		07:24 17:49			07:21 16:30
Potential sun hours	294	296	370	401	451	456	463	430	375	344		295	284
Total, worst case			508						414		100		
Sun reduction			0.58						0.56		0.55		
Oper. time red.			0.96						0.96		0.96		
Wind dir. red.			0.74						0.74		0.74		
Total reduction			0.41						0.40		0.39		
Total, real			208						164		39		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)

Project: **Otis** Description: Real Case Shadow Flicker Assessment for Town of Otis - Algeria Rd. Site
 GE 1.7 103m Rotor 80m Hub
 Real Case Statistics:
 Average Percent of Possible Sunshine (APPS) Obtained from NOAA - National Climatic Data Center (www.ncdc.noaa.gov)
 APPS Gathered at Blue Hill Observatory in Milton, MA (Data Span 1896-2009)

Printed/Page: 9/4/2015 11:06 AM / 6
 Licensed user: **SED, Inc.**
 317 State Route 104
 US-14519 Ontario, NY
 4738
 Scott Abbett / scott.abbett@sed-net.com
 Calculated: 9/3/2015 1:59 PM/2.7.486

SHADOW - Calendar

Calculation: Otis Shadow Flicker - Algeria Rd. REAL CASE Shadow receptor: E - SR9

Assumptions for shadow calculations

Maximum distance for influence 2,000 m
 Minimum sun height over horizon for influence 3 °
 Day step for calculation 1 days
 Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) []
 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
 4.36 5.29 6.92 7.87 7.57 8.36 8.51 8.05 7.00 6.10 4.62 4.21

Operational time
 N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum
 442 226 352 623 302 199 233 473 992 1,070 1,285 2,170 8,367

Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:22 16:31	07:07 17:06	06:29 17:42	06:37 19:18	07:16 (1) 19:51	05:49 20:21	05:20 20:33	05:45 20:14	06:17 19:28	06:49 18:36	06:25 16:47	07:01 16:22
2	07:22 16:32	07:06 17:08	06:28 17:43	06:35 19:19	07:17 (1) 19:52	05:48 20:22	05:19 20:33	05:46 20:13	06:18 19:26	06:50 18:34	06:26 16:46	07:02 16:21
3	07:22 16:32	07:05 17:09	06:26 17:44	06:33 19:20	07:18 (1) 19:53	05:47 20:23	05:18 20:33	05:47 20:12	06:19 19:24	06:51 18:32	06:27 16:45	07:03 16:21
4	07:22 16:33	07:04 17:10	06:24 17:45	06:31 19:21	07:21 (1) 19:54	05:45 20:23	05:18 20:33	05:48 20:10	06:20 19:23	06:52 18:30	06:29 16:43	07:04 16:21
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10	07:21 16:39	06:57 17:18	07:14 18:53	06:21 19:28	05:38 20:00	05:16 20:27	05:25 20:31	05:54 20:03	06:27 19:12	07:10 (1) 18:20	06:36 16:37	07:10 16:20
11	07:21 16:41	06:55 17:19	07:13 18:54	06:20 19:29	05:37 20:01	05:16 20:28	05:26 20:30	05:55 20:02	06:28 19:11	07:09 (1) 18:19	06:37 16:36	07:11 16:20
12	07:20 16:42	06:54 17:20	07:11 18:55	06:18 19:30	05:36 20:02	05:16 20:29	05:27 20:30	05:56 20:00	06:29 19:09	07:07 (1) 18:17	06:39 16:35	07:12 16:21
13	07:20 16:43	06:53 17:22	07:09 18:56	06:16 19:31	05:34 20:03	05:16 20:29	05:27 20:29	05:57 19:57	06:30 19:07	07:06 (1) 18:15	06:40 16:34	07:12 16:21
14	07:20 16:44	06:51 17:23	07:08 18:57	06:15 19:32	05:33 20:04	05:16 20:30	05:28 20:29	05:58 19:56	06:31 19:05	07:05 (1) 18:14	06:41 16:33	07:13 16:21
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16	07:19 16:46	06:49 17:26	07:04 19:00	06:12 19:34	05:31 20:06	05:16 20:30	05:30 20:28	06:00 19:53	06:33 19:02	07:04 (1) 18:10	06:43 16:31	07:15 16:21
17	07:18 16:47	06:47 17:27	07:03 19:01	06:10 19:36	05:30 20:07	05:16 20:31	05:31 20:27	06:01 19:52	06:34 19:00	07:03 (1) 18:09	06:45 16:30	07:15 16:22
18	07:18 16:49	06:46 17:28	07:01 19:02	06:08 19:37	05:29 20:08	05:16 20:31	05:31 20:26	06:02 19:50	06:35 18:58	07:03 (1) 18:07	06:46 16:29	07:16 16:22
19	07:17 16:50	06:44 17:29	06:59 19:03	06:07 19:38	05:28 20:09	05:16 20:32	05:32 20:26	06:03 19:49	06:36 18:57	07:03 (1) 18:06	06:47 16:28	07:17 16:22
20	07:17 16:51	06:43 17:31	06:57 19:04	06:05 19:39	05:28 20:10	05:16 20:32	05:33 20:25	06:04 19:47	06:37 18:55	07:03 (1) 18:04	06:48 16:28	07:17 16:23
21	07:16 16:52	06:41 17:32	06:56 19:05	06:04 19:40	05:27 20:11	05:16 20:32	05:34 20:24	06:06 19:46	06:38 18:53	07:03 (1) 18:03	06:50 16:27	07:18 16:23
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23	07:15 16:55	06:39 17:34	06:52 19:08	06:01 19:42	05:25 20:13	05:17 20:33	05:36 20:23	06:08 19:42	06:40 18:50	07:03 (1) 18:00	06:52 16:26	07:19 16:24
24	07:14 16:56	06:37 17:36	06:50 19:09	05:59 19:43	05:24 20:14	05:17 20:33	05:37 20:22	06:09 19:41	06:41 18:48	07:05 (1) 17:58	06:53 16:25	07:19 16:25
25	07:13 16:57	06:35 17:37	06:49 19:10	05:58 19:44	05:24 20:15	05:17 20:33	05:38 20:21	06:10 19:39	06:42 18:46	07:06 (1) 17:57	06:54 16:24	07:20 16:25
26	07:12 16:58	06:34 17:38	06:47 19:11	05:56 19:46	05:23 20:16	05:18 20:33	05:39 20:20	06:11 19:38	06:43 18:44	07:08 (1) 17:55	06:55 16:24	07:20 16:26
27	07:11 17:00	06:32 17:39	06:45 19:12	05:55 19:47	05:22 20:17	05:18 20:33	05:40 20:19	06:12 19:36	06:45 18:42	07:10 (1) 17:54	06:57 16:23	07:20 16:27
28	07:11 17:01	06:31 17:41	06:43 19:13	05:53 19:48	05:21 20:18	05:18 20:33	05:41 20:18	06:13 19:34	06:46 18:41	07:30 (1) 17:53	06:58 16:23	07:21 16:27
29	07:10 17:02		06:42 19:14	05:52 19:49	05:21 20:19	05:19 20:33	05:42 20:17	06:14 19:33	06:47 18:39	07:21 17:51	06:59 16:22	07:21 16:28
30	07:09 17:04		06:40 19:15	05:51 19:50	05:20 20:20	05:19 20:33	05:43 20:16	06:15 19:31	06:48 18:37	07:22 17:50	07:00 16:22	07:21 16:29
31	07:08 17:05		06:38 19:17	05:49 19:44	05:20 20:20	05:20 20:15	05:44 19:29	06:16 19:29		07:24 17:49	07:21 16:30	07:21 16:30
Potential sun hours	294	296	370	401	451	456	463	430	375	344	295	284
Total, worst case			440	92					536			
Sun reduction			0.58	0.59					0.56			
Oper. time red.			0.96	0.96					0.96			
Wind dir. red.			0.74	0.74					0.74			
Total reduction			0.41	0.42					0.39			
Total, real			180	38					211			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)		Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project: **Otis** Description: Real Case Shadow Flicker Assessment for Town of Otis - Algeria Rd. Site
 GE 1.7 103m Rotor 80m Hub
 Real Case Statistics:
 Average Percent of Possible Sunshine (APPS) Obtained from NOAA - National Climatic Data Center (www.ncdc.noaa.gov)
 APPS Gathered at Blue Hill Observatory in Milton, MA (Data Span 1896-2009)

Printed/Page: 9/4/2015 11:06 AM / 7
 Licensed user: **SED, Inc.**
 317 State Route 104
 US-14519 Ontario, NY
 4738
 Scott Abbett / scott.abbett@sed-net.com
 Calculated: 9/3/2015 1:59 PM/2.7.486

SHADOW - Calendar

Calculation: Otis Shadow Flicker - Algeria Rd. REAL CASE Shadow receptor: F - SR10A

Assumptions for shadow calculations

Maximum distance for influence 2,000 m
 Minimum sun height over horizon for influence 3 °
 Day step for calculation 1 days
 Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) []
 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
 4.36 5.29 6.92 7.87 7.57 8.36 8.51 8.05 7.00 6.10 4.62 4.21
 Operational time
 N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum
 442 226 352 623 302 199 233 473 992 1,070 1,285 2,170 8,367
 Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December		
1	07:22 16:31	07:07 17:06	06:29 17:42	06:37 19:18	06:58 (1) 07:21 (1)	05:49 19:51	05:19 20:21	05:20 20:33	05:45 20:14	06:17 19:28	06:51 (1) 07:19 (1)	06:49 18:36	06:25 16:47	07:01 16:22
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5	07:22 16:34	07:03 17:11	06:23 17:47	06:30 19:22	06:53 (1) 07:23 (1)	05:44 19:56	05:17 20:24	05:22 20:32	05:49 20:09	06:21 19:21	06:49 (1) 07:19 (1)	06:53 18:29	06:30 16:42	07:05 16:21
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12	07:20 16:42	06:54 17:21	07:11 18:55	06:18 19:30	06:52 (1) 07:18 (1)	05:36 20:02	05:16 20:29	05:27 20:30	05:56 20:00	06:29 19:09	06:50 (1) 07:12 (1)	07:01 18:17	06:39 16:35	07:12 16:21
13	07:20 16:43	06:53 17:22	07:09 18:56	06:16 19:31	06:54 (1) 07:18 (1)	05:34 20:03	05:16 20:29	05:27 20:29	05:57 19:57	06:30 19:07	06:52 (1) 07:10 (1)	07:02 18:15	06:40 16:34	07:12 16:21
14	07:20 16:44	06:51 17:23	07:08 18:57	06:15 19:32	06:54 (1) 07:16 (1)	05:33 20:04	05:16 20:29	05:28 20:29	05:58 19:56	06:31 19:05	06:54 (1) 07:07 (1)	07:03 18:14	06:41 16:33	07:13 16:21
15	07:19 16:45	06:50 17:24	07:06 18:58	06:13 19:33	06:56 (1) 07:14 (1)	05:32 20:05	05:16 20:30	05:29 20:28	05:59 19:55	06:32 19:04	07:04 18:12	07:04 16:32	06:42 16:21	07:14 16:21
16	07:19 16:46	06:49 17:26	07:04 19:00	06:12 19:34	06:58 (1) 07:11 (1)	05:31 20:06	05:16 20:30	06:00 20:28	06:00 19:53	06:33 19:02	07:06 18:10	07:06 16:31	06:43 16:21	07:15 16:20
17	07:18 16:47	06:47 17:27	07:03 19:01	06:10 19:36	07:01 (1) 07:07 (1)	05:30 20:07	05:16 20:31	06:01 20:27	06:01 19:52	06:34 19:00	07:07 18:09	06:45 16:30	06:45 16:22	07:15 16:22
18	07:18 16:49	06:46 17:28	07:01 19:02	06:08 19:37	06:46 20:08	05:29 20:31	05:16 20:26	06:02 19:50	06:02 18:58	06:35 18:58	07:08 18:07	06:46 16:29	06:46 16:22	07:16 16:22
19	07:17 16:50	06:44 17:29	06:59 19:03	06:07 19:38	06:44 20:09	05:28 20:32	05:16 20:26	06:03 19:49	06:03 18:57	06:36 18:57	07:09 18:06	06:47 16:28	06:47 16:22	07:17 16:22
20	07:17 16:51	06:43 17:31	06:57 19:04	06:05 19:39	06:43 20:10	05:28 20:32	05:16 20:25	06:04 19:47	06:04 18:55	06:37 18:55	07:10 18:04	06:48 16:28	06:48 16:23	07:17 16:23
21	07:16 16:52	06:41 17:32	06:56 19:05	06:04 19:40	06:41 20:11	05:27 20:32	05:16 20:24	06:06 19:46	06:06 18:53	06:38 18:53	07:11 18:03	06:50 16:27	06:48 16:23	07:18 16:23
22	07:15 16:53	06:40 17:33	06:54 19:06	06:02 19:41	06:40 20:12	05:26 20:32	05:16 20:23	06:07 19:44	06:07 18:51	06:39 18:51	07:13 18:01	06:51 16:26	06:48 16:24	07:18 16:24
23	07:15 16:55	06:39 17:34	06:52 19:08	06:01 19:42	06:39 20:13	05:25 20:33	05:17 20:23	06:08 19:42	06:08 18:50	06:40 18:50	07:14 18:00	06:52 16:26	06:48 16:24	07:19 16:24
24	07:14 16:56	06:37 17:36	06:50 19:09	05:59 19:43	06:37 20:14	05:24 20:33	05:17 20:22	06:09 19:41	06:09 18:48	06:41 18:48	07:15 17:58	06:53 16:25	06:48 16:25	07:19 16:25
25	07:13 16:57	06:35 17:37	06:49 19:10	05:58 19:45	06:35 20:15	05:24 20:33	05:17 20:21	06:10 19:39	06:10 18:46	06:42 18:46	07:16 17:57	06:54 16:24	06:48 16:25	07:20 16:25
26	07:12 16:58	06:34 17:38	06:47 19:11	05:56 19:46	06:34 20:16	05:23 20:33	05:18 20:20	06:11 19:38	06:11 18:44	06:43 18:44	07:17 17:55	06:55 16:24	06:48 16:26	07:20 16:26
27	07:11 17:00	06:32 17:39	06:45 19:12	05:55 19:47	06:32 20:17	05:22 20:33	05:18 20:19	06:12 19:36	06:12 18:42	06:45 18:42	07:19 17:54	06:57 16:23	06:48 16:27	07:20 16:27
28	07:11 17:01	06:31 17:41	06:43 19:13	05:53 19:48	06:31 20:18	05:21 20:33	05:18 20:18	06:13 19:34	06:13 18:41	06:46 18:41	07:20 17:53	06:58 16:23	06:48 16:27	07:21 16:27
29	07:10 17:02	06:30 19:14	06:42 19:14	05:52 07:04 (1)	06:30 07:16 (1)	05:21 19:49	05:19 20:33	06:14 19:33	06:14 18:39	06:47 18:39	07:21 17:51	06:59 16:22	06:48 16:28	07:21 16:28
30	07:09 17:04	06:30 19:15	06:40 19:15	05:51 07:01 (1)	06:29 07:18 (1)	05:20 19:50	05:19 20:33	06:15 20:16	06:15 19:31	06:48 18:37	07:22 17:50	07:00 16:22	06:48 16:29	07:21 16:29
31	07:08 17:05	06:30 19:17	06:38 19:17	05:50 07:20 (1)	06:28 07:20 (1)	05:20 20:20	05:19 20:15	06:16 19:29	06:16 18:41	06:48 17:49	07:24 17:49	07:21 16:24	06:48 16:30	07:21 16:30
Potential sun hours	294	296	370	401	451	456	463	430	375	344	295	284		
Total, worst case			50	421				112		366				
Sun reduction			0.58	0.59				0.58		0.56				
Oper. time red.			0.96	0.96				0.96		0.96				
Wind dir. red.			0.73	0.73				0.73		0.73				
Total reduction			0.40	0.41				0.40		0.39				
Total, real			20	172				45		142				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)

Project: **Otis** Description: Real Case Shadow Flicker Assessment for Town of Otis - Algerie Rd. Site
 GE 1.7 103m Rotor 80m Hub
 Real Case Statistics:
 Average Percent of Possible Sunshine (APPS) Obtained from NOAA - National Climatic Data Center (www.ncdc.noaa.gov)
 APPS Gathered at Blue Hill Observatory in Milton, MA (Data Span 1896-2009)

Printed/Page: 9/4/2015 11:06 AM / 8
 Licensed user: **SED, Inc.**
 317 State Route 104
 US-14519 Ontario, NY
 4738
 Scott Abbett / scott.abbett@sed-net.com
 Calculated: 9/3/2015 1:59 PM/2.7.486

SHADOW - Calendar

Calculation: Otis Shadow Flicker - Algerie Rd. REAL CASE Shadow receptor: G - SR10

Assumptions for shadow calculations

Maximum distance for influence 2,000 m
 Minimum sun height over horizon for influence 3 °
 Day step for calculation 1 days
 Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) []
 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
 4.36 5.29 6.92 7.87 7.57 8.36 8.51 8.05 7.00 6.10 4.62 4.21

Operational time
 N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum
 442 226 352 623 302 199 233 473 992 1,070 1,285 2,170 8,367
 Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December		
1	07:22 16:31	07:07 17:06	06:29 17:42	06:37 19:18	05:49 19:51	05:19 20:21	05:20 20:33	05:45 20:14	06:17 19:28	06:42 (1) 07:11 (1)	06:49 18:36	06:25 16:47	07:01 16:22	
2	07:22 16:32	07:06 17:08	06:28 17:43	06:35 19:19	05:48 19:52	05:19 20:22	05:20 20:33	05:46 20:13	06:18 19:26	06:42 (1) 07:10 (1)	06:50 18:34	06:26 16:46	07:02 16:21	
3	07:22 16:32	07:05 17:09	06:26 17:44	06:33 19:20	05:47 19:53	05:18 20:23	05:21 20:33	05:47 20:12	06:19 19:24	06:42 (1) 07:10 (1)	06:51 18:32	06:27 16:45	07:03 16:21	
4	07:22 16:33	07:04 17:10	06:24 17:45	06:31 19:21	06:54 (1) 07:06 (1)	05:45 19:54	05:18 20:23	05:21 20:10	05:48 19:23	06:20 07:08 (1)	06:52 18:30	06:29 16:43	07:04 16:21	
5	07:22 16:34	07:03 17:11	06:23 17:47	06:30 19:22	06:51 (1) 07:08 (1)	05:44 19:56	05:17 20:24	05:22 20:32	05:49 20:09	06:21 19:21	06:43 (1) 07:07 (1)	06:53 18:29	06:30 16:42	07:05 16:21
6	07:22 16:35	07:01 17:13	06:21 17:48	06:28 19:23	06:48 (1) 07:09 (1)	05:43 19:57	05:17 20:25	05:22 20:32	05:50 20:08	06:22 19:19	06:44 (1) 07:05 (1)	06:54 18:27	06:31 16:41	07:06 16:21
7	07:22 16:36	07:00 17:14	06:19 17:49	06:26 19:24	06:47 (1) 07:11 (1)	05:41 19:58	05:17 20:26	05:23 20:32	05:51 20:07	06:23 19:18	06:46 (1) 07:03 (1)	06:55 18:25	06:32 16:40	07:07 16:20
8	07:21 16:37	06:59 17:15	07:18 18:50	06:25 19:25	06:46 (1) 07:11 (1)	05:40 19:59	05:17 20:26	05:24 20:32	05:52 20:05	06:24 19:16	06:48 (1) 07:00 (1)	06:57 18:24	06:34 16:39	07:08 16:20
9	07:21 16:38	06:58 17:17	07:16 18:51	06:23 19:27	06:44 (1) 07:12 (1)	05:39 20:00	05:16 20:27	05:24 20:31	05:53 20:04	06:26 19:14	06:58 18:22	06:35 16:38	07:09 16:20	
10	07:21 16:39	06:57 17:18	07:14 18:53	06:21 19:28	06:44 (1) 07:13 (1)	05:38 20:00	05:16 20:27	05:25 20:31	05:54 20:03	06:27 19:12	06:59 18:20	06:36 16:37	07:10 16:20	
11	07:21 16:41	06:55 17:19	07:13 18:54	06:20 19:29	06:43 (1) 07:12 (1)	05:37 20:01	05:16 20:28	05:26 20:30	05:55 20:02	06:28 19:11	07:00 18:19	06:37 16:36	07:11 16:20	
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16	07:19 16:46	06:49 17:26	07:04 19:00	06:12 19:34	06:42 (1) 07:11 (1)	05:31 20:06	05:16 20:30	06:00 20:28	06:00 19:53	06:33 19:02	07:06 18:10	06:43 16:31	07:15 16:21	
17	07:18 16:47	06:47 17:27	07:03 19:01	06:10 19:36	06:41 (1) 07:09 (1)	05:30 20:07	05:16 20:31	06:01 20:27	06:01 19:52	06:34 19:00	07:07 18:09	06:45 16:30	07:15 16:22	
18	07:18 16:49	06:46 17:28	07:01 19:02	06:08 19:37	06:42 (1) 07:09 (1)	05:29 20:08	05:16 20:31	06:02 20:26	06:02 19:50	06:35 18:58	07:08 18:07	06:46 16:29	07:16 16:22	
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20	07:17 16:51	06:43 17:31	06:57 19:04	06:05 19:39	06:44 (1) 07:07 (1)	05:28 20:10	05:16 20:32	06:04 20:25	06:04 19:47	06:37 07:06 (1)	06:37 18:55	06:48 16:28	07:17 16:23	
21	07:16 16:52	06:41 17:32	06:56 19:05	06:04 19:40	06:44 (1) 07:05 (1)	05:27 20:11	05:16 20:32	06:06 20:24	06:06 19:46	06:38 07:08 (1)	06:38 18:53	06:50 16:27	07:18 16:23	
22	07:15 16:53	06:40 17:33	06:54 19:06	06:02 19:41	06:46 (1) 07:03 (1)	05:26 20:12	05:16 20:32	06:07 19:44	06:07 21	06:39 07:10 (1)	06:39 18:51	06:51 16:26	07:18 16:24	
23	07:15 16:55	06:39 17:34	06:52 19:08	06:01 19:42	06:48 (1) 07:00 (1)	05:25 20:13	05:17 20:33	06:08 20:23	06:08 19:42	06:48 (1) 07:11 (1)	06:40 18:50	06:52 16:26	07:19 16:24	
24	07:14 16:56	06:37 17:36	06:50 19:09	05:59 19:43	05:24 20:14	05:17 20:33	05:37 20:22	06:09 19:41	06:09 25	06:41 (1) 07:11 (1)	06:41 18:48	06:53 16:25	07:19 16:25	
25	07:13 16:57	06:35 17:37	06:49 19:10	05:58 19:45	05:24 20:15	05:17 20:33	05:38 20:21	06:10 19:39	06:10 27	06:45 (1) 07:12 (1)	06:42 18:46	06:54 16:24	07:20 16:25	
26	07:12 16:58	06:34 17:38	06:47 19:11	05:56 19:46	05:23 20:16	05:18 20:33	05:39 20:20	06:11 19:38	06:11 28	06:44 (1) 07:12 (1)	06:43 18:44	06:55 16:24	07:20 16:26	
27	07:11 17:00	06:32 17:39	06:45 19:12	05:55 19:47	05:22 20:17	05:18 20:33	05:40 20:19	06:12 19:36	06:12 29	06:44 (1) 07:13 (1)	06:45 18:42	06:57 16:23	07:20 16:27	
28	07:11 17:01	06:31 17:41	06:43 19:13	05:53 19:48	05:21 20:18	05:18 20:33	05:41 20:18	06:13 19:34	06:13 30	06:43 (1) 07:13 (1)	06:46 18:41	06:58 16:23	07:21 16:27	
29	07:10 17:02		06:42 19:14	05:52 19:49	05:21 20:19	05:19 20:33	05:42 20:17	06:14 19:33	06:14 30	06:42 (1) 07:12 (1)	06:47 18:39	06:59 16:22	07:21 16:28	
30	07:09 17:04		06:40 19:15	05:51 19:50	05:20 20:20	05:19 20:33	05:43 20:16	06:15 19:31	06:15 30	06:42 (1) 07:12 (1)	06:48 18:37	07:00 16:22	07:21 16:29	
31	07:08 17:05		06:38 19:17		05:20 20:20		05:44 20:15	06:16 19:29	06:16 30	06:42 (1) 07:12 (1)		07:24 17:49	07:21 16:30	
Potential sun hours	294	296	370	401	451	456	463	430	375		344	295	284	
Total, worst case				487				307		184				
Sun reduction				0.59				0.58		0.56				
Oper. time red.				0.96				0.96		0.96				
Wind dir. red.				0.72				0.72		0.72				
Total reduction				0.40				0.40		0.38				
Total, real				197				122		71				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)

Project: **Otis** Description: Real Case Shadow Flicker Assessment for Town of Otis - Algeria Rd. Site
 GE 1.7 103m Rotor 80m Hub
 Real Case Statistics:
 Average Percent of Possible Sunshine (APPS) Obtained from NOAA - National Climatic Data Center (www.ncdc.noaa.gov)
 APPS Gathered at Blue Hill Observatory in Milton, MA (Data Span 1896-2009)

Printed/Page: 9/4/2015 11:06 AM / 9
 Licensed user: **SED, Inc.**
 317 State Route 104
 US-14519 Ontario, NY
 4738
 Scott Abbett / scott.abbett@sed-net.com
 Calculated: 9/3/2015 1:59 PM/2.7.486

SHADOW - Calendar

Calculation: Otis Shadow Flicker - Algeria Rd. REAL CASE Shadow receptor: H - SR11

Assumptions for shadow calculations

Maximum distance for influence 2,000 m
 Minimum sun height over horizon for influence 3 °
 Day step for calculation 1 days
 Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) []
 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
 4.36 5.29 6.92 7.87 7.57 8.36 8.51 8.05 7.00 6.10 4.62 4.21

Operational time
 N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum
 442 226 352 623 302 199 233 473 992 1,070 1,285 2,170 8,367
 Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December		
1	07:22 16:31	07:07 17:06	06:29 17:42	06:37 19:18	05:49 19:51	06:37 (1) 07:01 (1)	05:19 20:21	05:20 20:33	05:45 20:14	06:17 19:28	06:43 (1) 07:03 (1)	06:25 16:47	07:01 16:22	
2	07:22 16:32	07:06 17:08	06:28 17:43	06:35 19:19	05:48 19:52	06:39 (1) 06:59 (1)	05:19 20:22	05:20 20:33	05:46 20:13	06:18 19:26	06:45 (1) 07:00 (1)	06:26 16:46	07:02 16:21	
3	07:22 16:32	07:05 17:09	06:26 17:44	06:33 19:20	05:47 19:53	06:41 (1) 06:58 (1)	05:18 20:23	05:21 20:33	05:47 20:12	06:19 19:24	06:51 (1) 06:53 (1)	06:27 16:45	07:03 16:21	
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10	07:21 16:39	06:57 17:18	07:14 18:53	06:21 19:28	05:38 20:00	06:47 (1) 07:02 (1)	05:38 20:00	05:25 20:27	05:54 20:03	06:49 (1) 07:07 (1)	06:27 19:12	06:36 16:37	07:10 16:20	
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14	07:20 16:44	06:51 17:23	07:08 18:57	06:15 19:32	05:33 20:04	06:38 (1) 07:07 (1)	05:33 20:04	05:28 20:29	05:58 19:56	06:43 (1) 07:12 (1)	06:31 19:05	06:41 16:33	07:13 16:21	
15	07:19 16:45	06:50 17:24	07:06 18:58	06:13 19:33	05:32 20:05	06:35 (1) 07:09 (1)	05:32 20:05	05:29 20:28	05:59 19:55	06:42 (1) 07:12 (1)	06:32 19:04	06:42 16:32	07:14 16:21	
16	07:19 16:46	06:49 17:26	07:04 19:00	06:12 19:34	05:31 20:06	06:36 (1) 07:09 (1)	05:31 20:06	06:00 20:30	06:41 (1) 19:53	06:33 19:02	06:33 18:10	06:43 16:31	07:15 16:21	
17	07:18 16:47	06:47 17:27	07:03 19:01	06:10 19:36	05:30 20:07	06:35 (1) 07:08 (1)	05:30 20:07	06:01 20:31	06:01 19:52	06:40 (1) 07:13 (1)	06:34 19:00	06:45 16:30	07:15 16:22	
18	07:18 16:49	06:46 17:28	07:01 19:02	06:08 19:37	05:29 20:08	06:35 (1) 07:09 (1)	05:29 20:08	06:02 20:31	06:02 19:50	06:40 (1) 07:13 (1)	06:35 18:58	06:46 16:29	07:16 16:22	
19	07:17 16:50	06:44 17:29	06:59 19:03	06:07 19:38	05:28 20:09	06:34 (1) 07:09 (1)	05:28 20:09	06:03 20:32	06:03 19:49	06:39 (1) 07:14 (1)	06:36 18:57	06:47 16:28	07:17 16:22	
20	07:17 16:51	06:43 17:31	06:57 19:04	06:05 19:39	05:28 20:10	06:34 (1) 07:09 (1)	05:28 20:10	06:04 20:32	06:04 19:47	06:39 (1) 07:14 (1)	06:37 18:55	06:48 16:28	07:17 16:23	
21	07:16 16:52	06:41 17:32	06:56 19:05	06:04 19:40	05:27 20:11	06:33 (1) 07:09 (1)	05:27 20:11	06:06 20:32	06:06 19:46	06:38 (1) 07:14 (1)	06:38 18:53	06:50 16:27	07:18 16:23	
22	07:15 16:53	06:40 17:33	06:54 19:06	06:02 19:41	05:26 20:12	06:34 (1) 07:09 (1)	05:26 20:12	06:07 20:32	06:07 19:44	06:38 (1) 07:13 (1)	06:39 18:51	06:51 16:26	07:18 16:24	
23	07:15 16:55	06:39 17:34	06:52 19:08	06:01 19:42	05:25 20:13	06:33 (1) 07:08 (1)	05:25 20:13	06:08 20:33	06:08 19:42	06:38 (1) 07:13 (1)	06:40 18:50	06:52 16:26	07:19 16:24	
24	07:14 16:56	06:37 17:36	06:50 19:09	05:59 19:43	05:24 20:14	06:33 (1) 07:08 (1)	05:24 20:14	06:09 20:33	06:09 19:41	06:38 (1) 07:13 (1)	06:41 18:48	06:53 16:25	07:19 16:25	
25	07:13 16:57	06:35 17:37	06:49 19:10	05:58 19:44	05:24 20:15	06:33 (1) 07:07 (1)	05:24 20:15	06:10 20:33	06:10 19:39	06:38 (1) 07:12 (1)	06:42 18:46	06:54 16:24	07:20 16:25	
26	07:12 16:58	06:34 17:38	06:47 19:11	05:56 19:46	05:23 20:16	06:34 (1) 07:06 (1)	05:23 20:16	06:11 20:20	06:11 19:38	06:38 (1) 07:11 (1)	06:43 18:44	06:55 16:24	07:20 16:26	
27	07:11 17:00	06:32 17:39	06:45 19:12	05:55 19:47	05:22 20:17	06:35 (1) 07:06 (1)	05:22 20:17	06:12 20:33	06:12 19:36	06:38 (1) 07:10 (1)	06:45 18:42	06:57 16:23	07:20 16:27	
28	07:11 17:01	06:31 17:41	06:43 19:13	05:53 19:48	05:21 20:18	06:34 (1) 07:04 (1)	05:21 20:18	06:13 20:33	06:13 19:34	06:39 (1) 07:09 (1)	06:46 18:41	06:58 16:23	07:21 16:27	
29	07:10 17:02		06:42 19:14	05:52 19:49	05:21 20:19	06:36 (1) 07:04 (1)	05:21 20:19	06:14 20:33	06:14 19:33	06:39 (1) 07:08 (1)	06:47 18:39	06:59 16:22	07:21 16:28	
30	07:09 17:04		06:40 19:15	05:51 19:50	05:20 20:20	06:37 (1) 07:03 (1)	05:20 20:20	06:15 20:33	06:15 19:31	06:40 (1) 07:07 (1)	06:48 18:37	07:00 16:22	07:21 16:29	
31	07:08 17:05		06:38 19:17		05:20 20:20		05:20 20:20	06:16 20:15	06:16 19:29	06:41 (1) 07:05 (1)		07:21 17:49	07:21 16:30	
Potential sun hours	294	296	370	401	451		456	463	430	375		344	295	284
Total, worst case				640	72				685		37			
Sun reduction				0.59	0.52				0.58		0.56			
Oper. time red.				0.96	0.96				0.96		0.96			
Wind dir. red.				0.71	0.71				0.71		0.71			
Total reduction				0.40	0.35				0.39		0.38			
Total, real				256	25				269		14			

Table layout: For each day in each month the following matrix apply

Day in month Sun rise (hh:mm) Sun set (hh:mm) Minutes with flicker First time (hh:mm) with flicker Last time (hh:mm) with flicker (WTG causing flicker first time) (WTG causing flicker last time)

Project: **Otis** Description: Real Case Shadow Flicker Assessment for Town of Otis - Algeria Rd. Site
 GE 1.7 103m Rotor 80m Hub
 Real Case Statistics:
 Average Percent of Possible Sunshine (APPS) Obtained from NOAA - National Climatic Data Center (www.ncdc.noaa.gov)
 APPS Gathered at Blue Hill Observatory in Milton, MA (Data Span 1896-2009)

Printed/Page: 9/4/2015 11:06 AM / 10
 Licensed user: **SED, Inc.**
 317 State Route 104
 US-14519 Ontario, NY
 4738
 Scott Abbett / scott.abbett@sed-net.com
 Calculated: 9/3/2015 1:59 PM/2.7.486

SHADOW - Calendar

Calculation: Otis Shadow Flicker - Algeria Rd. REAL CASE Shadow receptor: I - SR14

Assumptions for shadow calculations

Maximum distance for influence 2,000 m
 Minimum sun height over horizon for influence 3 °
 Day step for calculation 1 days
 Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) []
 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
 4.36 5.29 6.92 7.87 7.57 8.36 8.51 8.05 7.00 6.10 4.62 4.21

Operational time
 N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum
 442 226 352 623 302 199 233 473 992 1,070 1,285 2,170 8,367
 Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December		
1	07:22 16:31	07:07 17:06	06:29 17:42	06:37 19:18	05:49 19:51	05:19 20:21	05:59 (1) 06:34 (1)	05:20 20:33	06:08 (1) 20:14	06:12 (1) 06:41 (1)	06:17 19:28	06:49 18:36	06:25 16:47	07:01 16:22
2	07:22 16:32	07:06 17:08	06:28 17:43	06:35 19:19	05:48 19:52	05:19 20:22	35 06:00 (1) 34 06:34 (1)	05:20 20:33	06:08 (1) 20:13	06:13 (1) 06:40 (1)	06:18 19:26	06:50 18:34	06:26 16:46	07:02 16:21
3	07:22 16:32	07:05 17:09	06:26 17:44	06:33 19:20	05:47 19:53	05:18 20:23	34 06:00 (1) 34 06:34 (1)	05:21 20:33	06:08 (1) 20:12	06:14 (1) 06:39 (1)	06:19 19:24	06:51 18:32	06:27 16:45	07:03 16:21
4	07:22 16:33	07:04 17:10	06:24 17:45	06:31 19:21	05:45 19:54	05:18 20:23	34 06:01 (1) 33 06:34 (1)	05:21 20:33	06:07 (1) 20:10	06:15 (1) 06:37 (1)	06:20 19:23	06:52 18:30	06:29 16:43	07:04 16:21
5	07:22 16:34	07:03 17:11	06:23 17:47	06:30 19:22	05:44 19:56	05:17 20:24	33 06:01 (1) 33 06:34 (1)	05:22 20:32	06:08 (1) 20:09	06:16 (1) 06:36 (1)	06:21 19:21	06:53 18:29	06:30 16:42	07:05 16:21
6	07:22 16:35	07:01 17:13	06:21 17:48	06:28 19:23	05:43 19:57	05:17 20:25	32 06:02 (1) 32 06:34 (1)	05:22 20:32	06:08 (1) 20:08	06:18 (1) 06:33 (1)	06:22 19:19	06:54 18:27	06:31 16:41	07:06 16:21
7	07:22 16:36	07:00 17:14	06:19 17:49	06:26 19:24	05:41 19:58	05:17 20:26	32 06:02 (1) 32 06:34 (1)	05:23 20:32	06:08 (1) 20:07	06:22 (1) 06:30 (1)	06:23 19:18	06:55 18:25	06:32 16:40	07:07 16:20
8	07:21 16:37	06:59 17:15	07:18 18:50	06:25 19:25	05:40 19:59	05:17 20:26	32 06:02 (1) 32 06:34 (1)	05:24 20:32	06:08 (1) 20:05	06:24 19:16	06:57 18:24	06:34 16:39	07:08 16:20	
9	07:21 16:38	06:58 17:17	07:16 18:51	06:23 19:27	05:39 20:00	05:16 20:27	31 06:03 (1) 31 06:34 (1)	05:24 20:31	06:07 (1) 20:04	06:26 19:14	06:58 18:22	06:35 16:38	07:09 16:20	
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13	07:20 16:43	06:53 17:22	07:09 18:56	06:16 19:31	05:34 20:03	05:16 20:29	29 06:04 (1) 29 06:33 (1)	05:27 20:29	06:07 (1) 19:57	06:30 19:07	07:02 18:15	06:40 16:34	07:12 16:21	
14	07:20 16:44	06:51 17:23	07:08 18:57	06:15 19:32	05:33 20:04	05:16 20:30	29 06:04 (1) 29 06:33 (1)	05:28 20:29	06:07 (1) 19:56	06:31 19:05	07:03 18:14	06:41 16:33	07:13 16:21	
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16	07:19 16:46	06:49 17:26	07:04 19:00	06:12 19:34	05:31 20:06	05:16 20:30	28 06:05 (1) 28 06:33 (1)	05:30 20:28	06:08 (1) 19:53	06:33 19:02	07:06 18:10	06:43 16:31	07:15 16:21	
17	07:18 16:47	06:47 17:27	07:03 19:01	06:10 19:36	05:30 20:07	05:16 20:31	28 06:06 (1) 28 06:34 (1)	05:31 20:27	06:07 (1) 19:52	06:34 19:00	07:07 18:09	06:45 16:30	07:15 16:22	
18	07:18 16:49	06:46 17:28	07:01 19:02	06:08 19:37	05:29 20:08	05:16 20:31	28 06:06 (1) 28 06:34 (1)	05:31 20:26	06:07 (1) 19:50	06:35 18:58	07:08 18:07	06:46 16:29	07:16 16:22	
19	07:17 16:50	06:44 17:29	06:59 19:03	06:07 19:38	05:28 20:09	05:16 20:32	27 06:07 (1) 27 06:34 (1)	05:32 20:26	06:07 (1) 19:49	06:36 18:57	07:09 18:06	06:47 16:28	07:17 16:22	
20	07:17 16:51	06:43 17:31	06:57 19:04	06:05 19:39	05:28 20:10	05:16 20:32	27 06:07 (1) 27 06:34 (1)	05:33 20:25	06:08 (1) 19:47	06:37 18:55	07:10 18:04	06:48 16:28	07:17 16:23	
21	07:16 16:52	06:41 17:32	06:56 19:05	06:04 19:40	05:27 20:11	05:16 20:32	27 06:07 (1) 27 06:34 (1)	05:34 20:24	06:08 (1) 19:46	06:38 18:53	07:11 18:03	06:50 16:27	07:18 16:23	
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23	07:15 16:55	06:39 17:34	06:52 19:08	06:01 19:42	05:25 20:13	05:17 20:33	27 06:08 (1) 27 06:35 (1)	05:36 20:23	06:08 (1) 19:42	06:40 18:50	07:14 18:00	06:52 16:26	07:19 16:24	
24	07:14 16:56	06:37 17:36	06:50 19:09	05:59 19:43	05:24 20:14	05:17 20:33	28 06:07 (1) 28 06:35 (1)	05:37 20:22	06:09 (1) 19:41	06:41 18:48	07:15 17:58	06:53 16:25	07:19 16:25	
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26	07:12 16:58	06:34 17:38	06:47 19:11	05:56 19:46	05:23 20:16	05:18 20:33	28 06:08 (1) 28 06:36 (1)	05:39 20:20	06:08 (1) 19:38	06:43 18:44	07:17 17:55	06:55 16:24	07:20 16:26	
27	07:11 17:00	06:32 17:39	06:45 19:12	05:55 19:47	05:22 20:17	05:18 20:33	28 06:08 (1) 28 06:36 (1)	05:40 20:19	06:09 (1) 19:36	06:45 18:42	07:19 17:54	06:57 16:23	07:20 16:27	
28	07:11 17:01	06:31 17:41	06:43 19:13	05:53 19:48	05:21 20:18	05:18 20:33	29 06:07 (1) 29 06:36 (1)	05:41 20:18	06:09 (1) 19:34	06:46 18:41	07:20 17:53	06:58 16:23	07:21 16:27	
29	07:10 17:02		06:42 19:14	05:52 19:49	05:21 20:19	05:19 20:33	29 06:08 (1) 29 06:37 (1)	05:42 20:17	06:10 (1) 19:33	06:47 18:39	07:21 17:51	06:59 16:22	07:21 16:28	
30	07:09 17:04		06:40 19:15	05:51 19:50	05:20 20:20	05:19 20:33	29 06:08 (1) 29 06:37 (1)	05:43 20:16	06:10 (1) 19:31	06:48 18:37	07:22 17:50	07:00 16:22	07:21 16:29	
31	07:08 17:05		06:38 19:17	05:50 20:20	05:20 20:20	05:19 20:33	30 06:11 (1) 30 06:41 (1)	06:16 19:29		07:24 17:49		07:21 16:30		
Potential sun hours	294	296	370	401	451	456	463	430		375	344	295	284	
Total, worst case					827	891	1058	146						
Sun reduction					0.52	0.55	0.57	0.58						
Oper. time red.					0.96	0.96	0.96	0.96						
Wind dir. red.					0.67	0.67	0.67	0.67						
Total reduction					0.33	0.35	0.37	0.37						
Total, real					276	314	387	54						

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)		Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project: **Otis** Description: Real Case Shadow Flicker Assessment for Town of Otis - Algeria Rd. Site
 GE 1.7 103m Rotor 80m Hub
 Real Case Statistics:
 Average Percent of Possible Sunshine (APPS) Obtained from NOAA - National Climatic Data Center (www.ncdc.noaa.gov)
 APPS Gathered at Blue Hill Observatory in Milton, MA (Data Span 1896-2009)

Printed/Page: 9/4/2015 11:06 AM / 11
 Licensed user: **SED, Inc.**
 317 State Route 104
 US-14519 Ontario, NY
 4738
 Scott Abbett / scott.abbett@sed-net.com
 Calculated: 9/3/2015 1:59 PM/2.7.486

SHADOW - Calendar

Calculation: Otis Shadow Flicker - Algeria Rd. REAL CASE Shadow receptor: J - SR15

Assumptions for shadow calculations

Maximum distance for influence 2,000 m
 Minimum sun height over horizon for influence 3 °
 Day step for calculation 1 days
 Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) []
 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
 4.36 5.29 6.92 7.87 7.57 8.36 8.51 8.05 7.00 6.10 4.62 4.21
 Operational time
 N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum
 442 226 352 623 302 199 233 473 992 1,070 1,285 2,170 8,367
 Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December			
1	07:22 16:31	07:07 17:06	06:29 17:42	06:37 19:18	05:49 19:51	05:19 20:21	06:04 (1) 06:27 (1)	05:20 20:33	06:17 (1) 20:14	05:45 29 06:39 (1)	06:10 (1) 19:28	06:17 18:36	06:49 16:47	06:25 16:22	07:01 16:22
2	07:22 16:32	07:06 17:08	06:28 17:43	06:35 19:19	05:48 19:52	05:19 20:22	06:05 (1) 06:27 (1)	05:20 20:33	06:16 (1) 20:13	05:46 27 06:38 (1)	06:11 (1) 19:26	06:18 18:34	06:50 16:46	06:26 16:21	07:02 16:21
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15	07:19 16:45	06:50 17:24	07:06 18:58	06:13 19:33	05:32 20:05	05:16 20:30	06:29 (1) 05:29	05:16 20:28	06:11 (1) 19:55	05:59 26 06:37 (1)	06:32 (1) 19:04	06:32 18:12	06:42 16:32	06:42 16:21	07:14 16:21
16	07:19 16:46	06:49 17:26	07:04 19:00	06:12 19:34	05:31 20:06	05:16 20:30	06:29 (1) 05:30	05:16 20:28	06:11 (1) 19:53	06:00 27 06:38 (1)	06:33 (1) 19:02	06:33 18:10	06:43 16:31	06:43 16:21	07:15 16:21
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26	07:12 16:58	06:34 17:38	06:47 19:11	05:56 19:46	05:23 20:16	05:18 20:33	06:29 (1) 05:39	05:18 20:20	06:09 (1) 19:38	06:11 31 06:40 (1)	06:43 (1) 18:44	06:43 17:55	06:55 16:24	06:55 16:26	07:20 16:26
27	07:11 17:00	06:32 17:39	06:45 19:12	05:55 19:47	05:22 20:17	05:18 20:33	06:29 (1) 05:40	05:18 20:19	06:09 (1) 19:36	06:12 31 06:40 (1)	06:44 (1) 18:42	06:44 17:54	06:57 16:23	06:57 16:27	07:20 16:27
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29	07:10 17:02		06:42 19:14	05:52 19:49	05:21 20:19	05:19 20:33	06:20 (1) 06:23 (1)	05:42 20:17	06:09 (1) 19:33	06:14 31 06:40 (1)	06:47 (1) 18:39	06:47 17:51	06:59 16:22	06:59 16:28	07:21 16:28
30	07:09 17:04		06:40 19:15	05:51 19:50	05:20 20:20	05:19 20:33	06:02 (1) 06:27 (1)	05:19 20:16	06:10 (1) 19:31	06:15 6 06:24 (1)	06:48 (1) 18:37	06:48 17:50	07:00 16:22	07:00 16:29	07:21 16:29
31	07:08 17:05		06:38 19:17	05:20 20:20	05:20 20:24	05:19 20:33	06:03 (1) 06:27 (1)	05:44 20:15	06:10 (1) 19:29	06:16 29 06:39 (1)	06:49 (1) 17:49	06:49 17:49	07:21 16:30	07:21 16:30	07:21 16:30
Potential sun hours	294	296	370	401	451	456	463	430			375	344	295	284	
Total, worst case					740	204	758	175							
Sun reduction					0.52	0.55	0.57	0.58							
Oper. time red.					0.96	0.96	0.96	0.96							
Wind dir. red.					0.67	0.67	0.67	0.67							
Total reduction					0.33	0.35	0.37	0.37							
Total, real					247	72	278	65							

Table layout: For each day in each month the following matrix apply

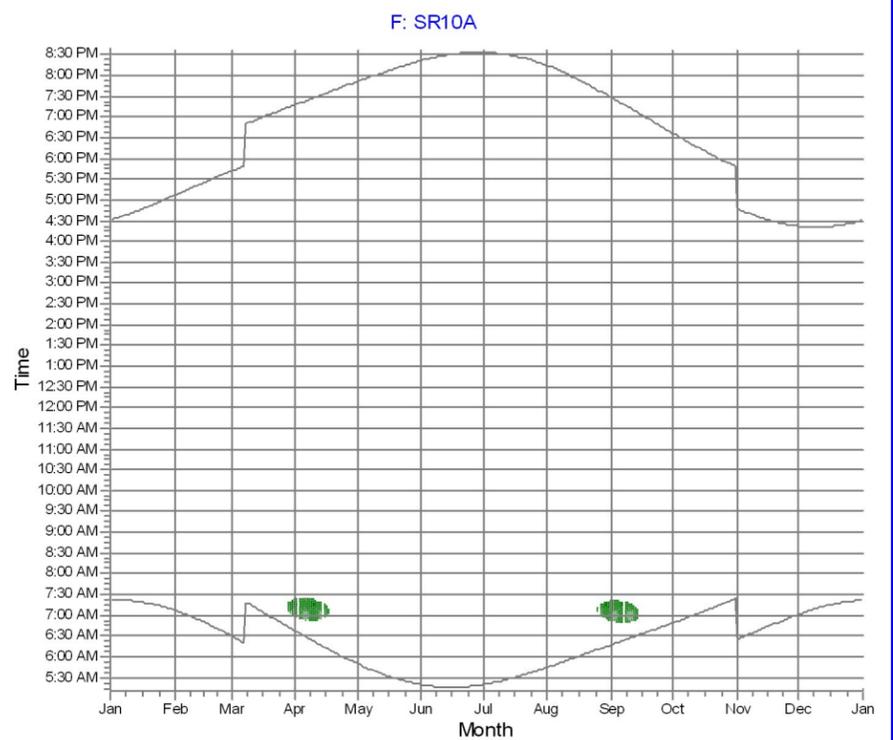
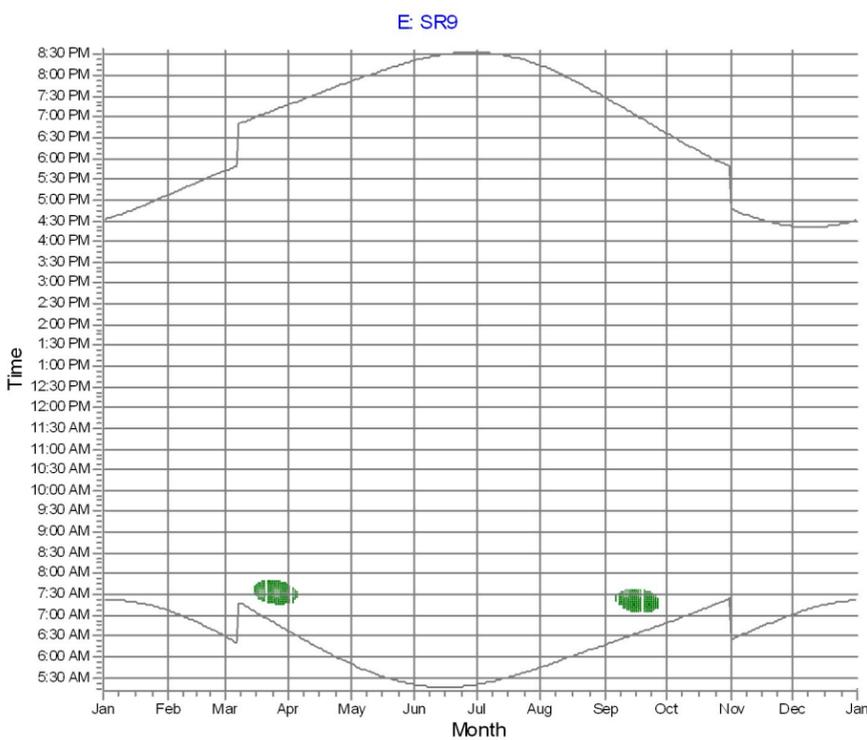
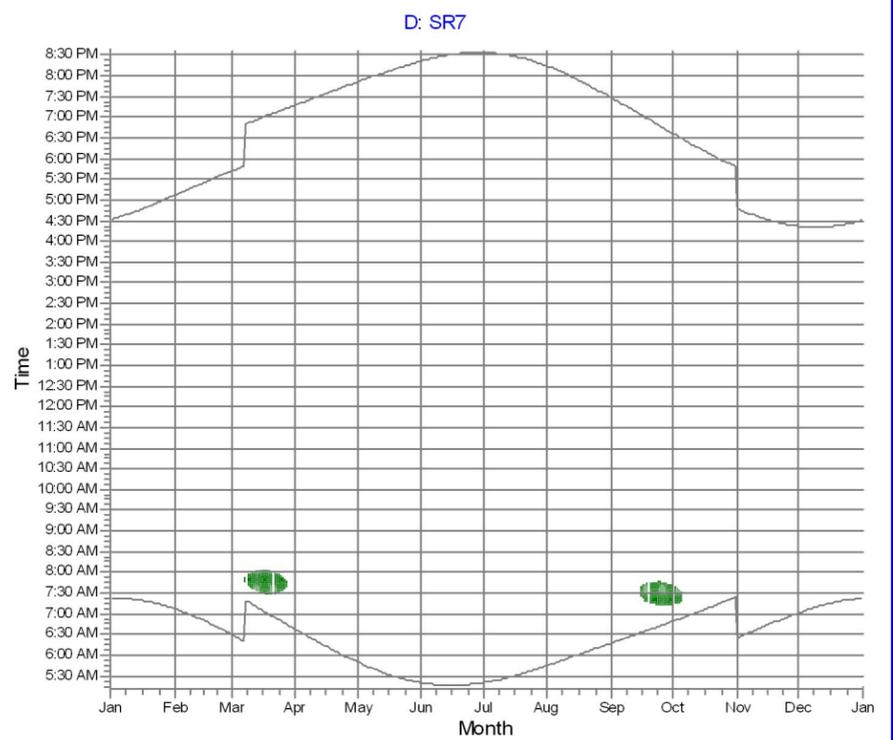
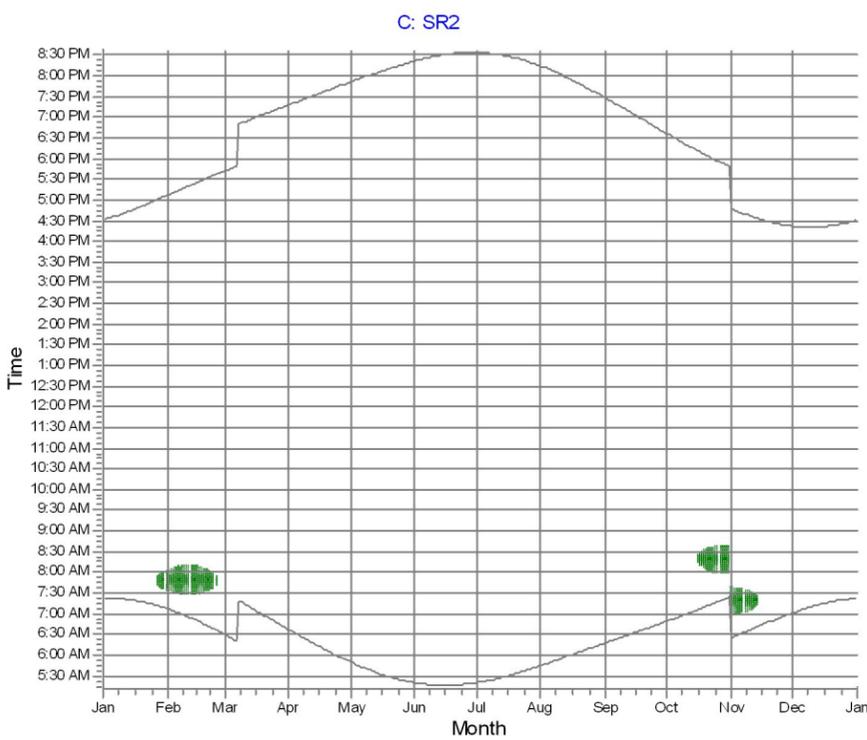
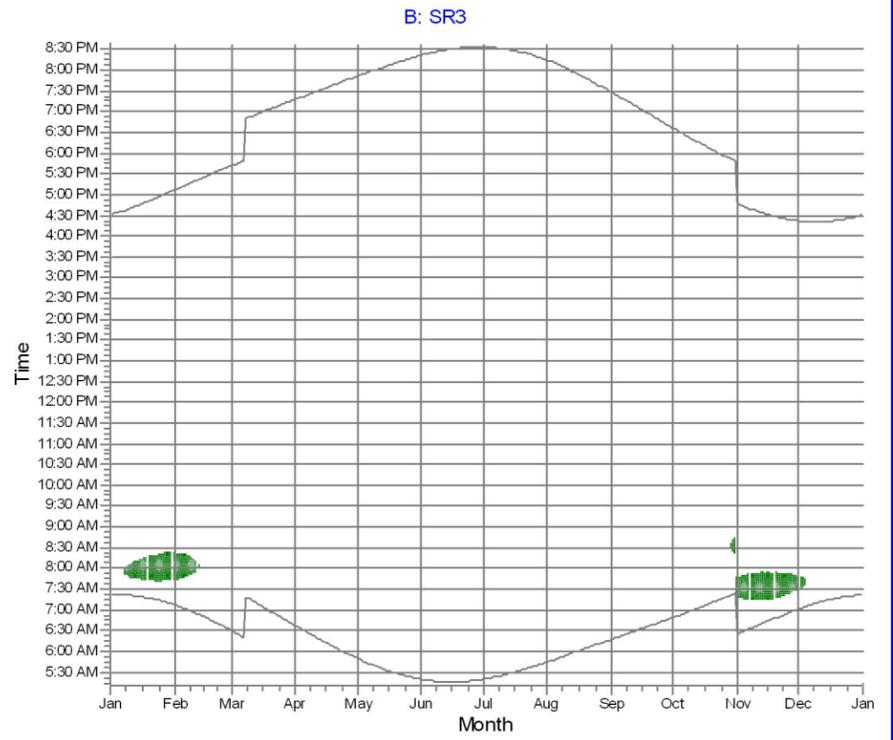
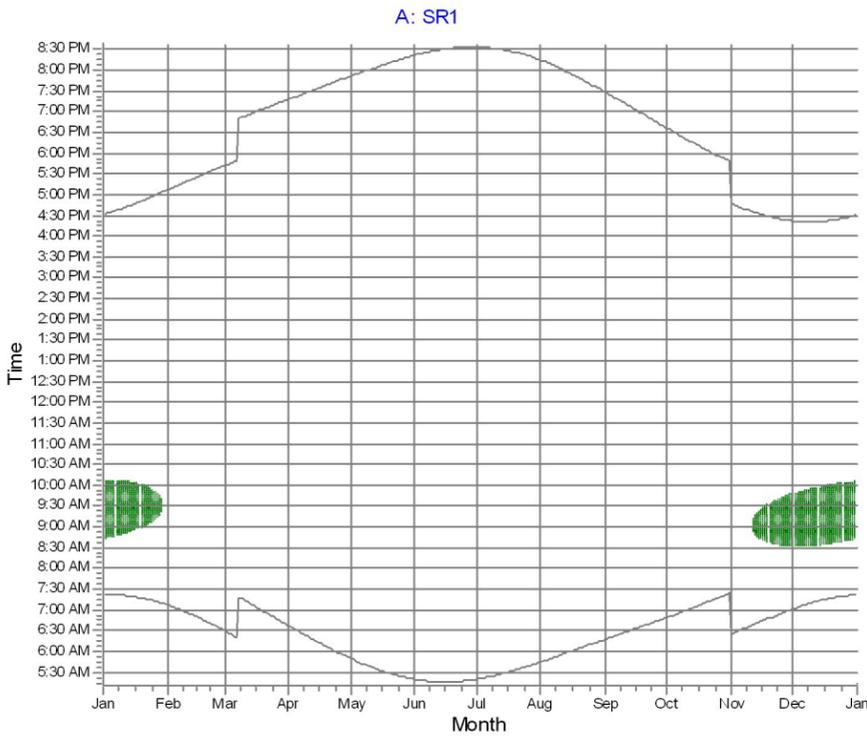
Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)		Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project: **Otis**
 Description: Real Case Shadow Flicker Assessment for Town of Otis - Algerie Rd. Site
 GE 1.7 103m Rotor 80m Hub
 Real Case Statistics:
 Average Percent of Possible Sunshine (APPS) Obtained from NOAA - National Climatic Data Center (www.ncdc.noaa.gov)
 APPS Gathered at Blue Hill Observatory in Milton, MA (Data Span 1896-2009)

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 317 State Route 104
 US-14519 Ontario, NY
 4738
 Scott Abbett / scott.abbett@sed-net.com
 Calculated: 9/3/2015 1:59 PM/2.7.486

SHADOW - Calendar, graphical

Calculation: Otis Shadow Flicker - Algerie Rd. REAL CASE



WTGs

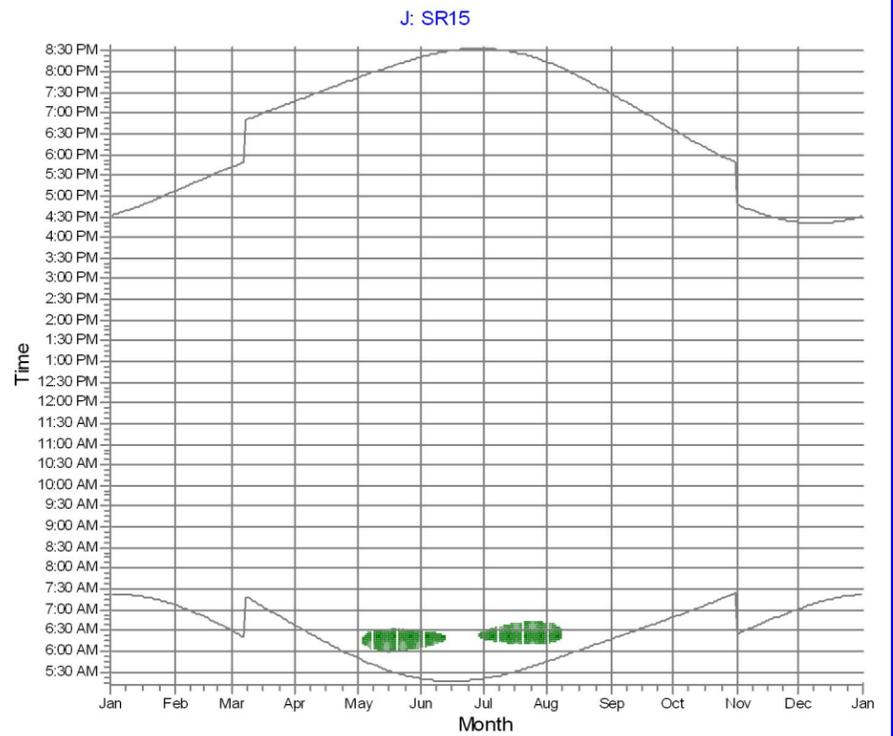
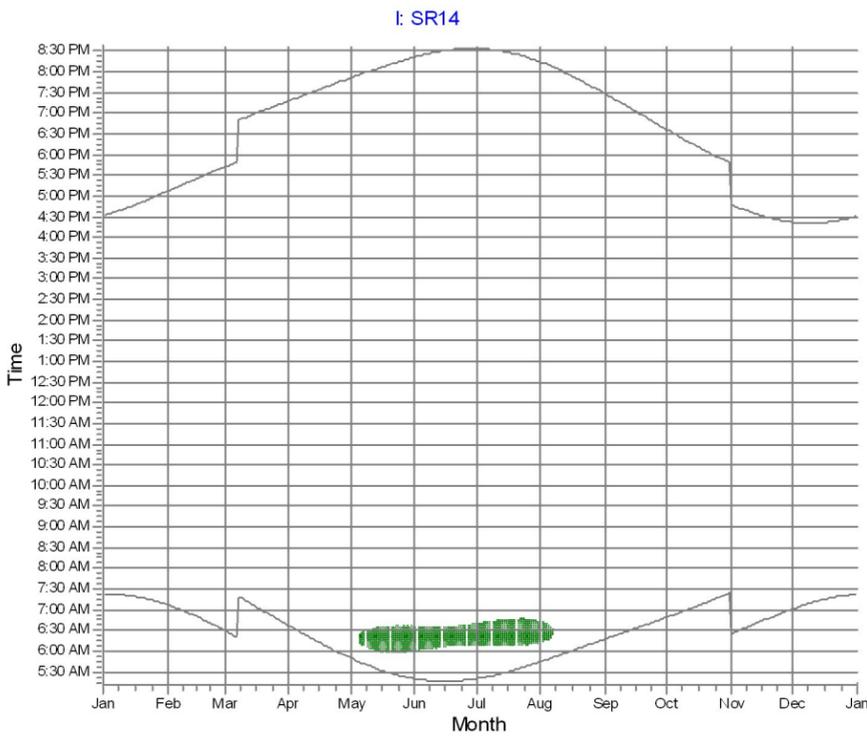
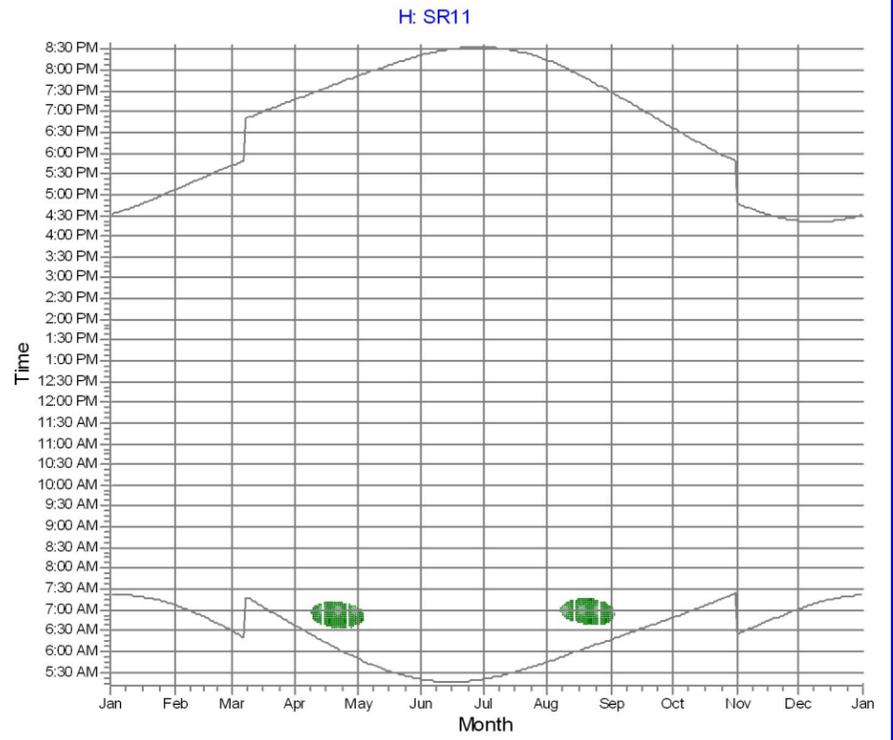
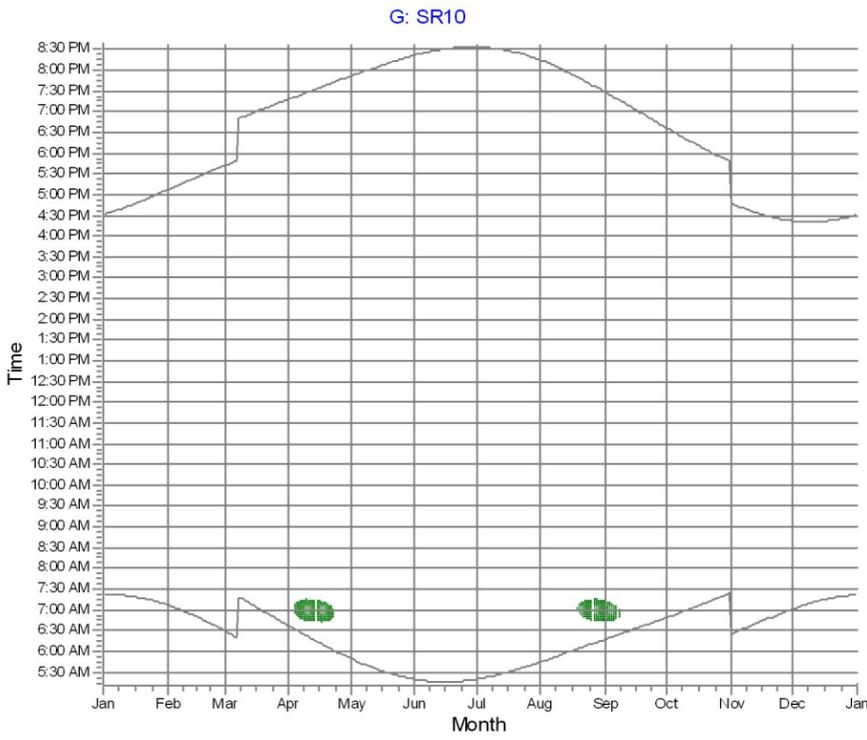
 1: GE 1.7 103m Rotor 80m Hub

Project: **Otis**
 Description: Real Case Shadow Flicker Assessment for Town of Otis - Algeria Rd. Site
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 317 State Route 104
 US-14519 Ontario, NY
 4738
 Scott Abbett / scott.abbett@sed-net.com
 Calculated: 9/3/2015 1:59 PM/2.7.486

SHADOW - Calendar, graphical

Calculation: Otis Shadow Flicker - Algeria Rd. REAL CASE



WTGs

 1: GE 1.7 103m Rotor 80m Hub

Project: **Otis**
 Description: Real Case Shadow Flicker Assessment for Town of Otis - Algeria Rd. Site
 GE 1.7 103m Rotor 80m Hub
 Real Case Statistics:
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 Calculated: 9/3/2015 1:59 PM/2.7.486

SHADOW - Calendar per WTG

Calculation: Otis Shadow Flicker - Algeria Rd. REAL CASE WTG: 1 - GE 1.7 103m Rotor 80m Hub

Assumptions for shadow calculations

Maximum distance for influence 2,000 m
 Minimum sun height over horizon for influence 3 °
 Day step for calculation 1 days
 Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) []
 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
 4.36 5.29 6.92 7.87 7.57 8.36 8.51 8.05 7.00 6.10 4.62 4.21

Operational time
 N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum
 442 226 352 623 302 199 233 473 992 1,070 1,285 2,170 8,367

Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June
1	07:22 08:42-10:04/82 16:31	07:07 07:33-08:02/29 17:06 08:02-08:20/18	06:29 17:42	06:37 06:58-07:22/24 19:18 07:22-07:42/20	05:49 06:37-07:01/24 19:51	05:19 05:59-06:28/29 20:21 06:28-06:34/6
2	07:22 08:42-10:04/82 16:32	07:06 07:31-08:02/31 17:07 08:02-08:19/17	06:28 17:43	06:35 06:56-07:23/27 19:19 07:23-07:40/17	05:48 06:39-06:59/20 19:52	05:19 06:00-06:28/28 20:22 06:28-06:34/6
3	07:22 08:43-10:04/81 16:32	07:05 07:31-08:04/33 17:09 08:04-08:19/15	06:26 17:44	06:33 06:54-07:23/29 19:20 07:23-07:38/15	05:46 06:41-06:58/17 19:53	05:18 06:00-06:27/27 20:23 06:27-06:34/7
4	07:22 08:44-10:04/80 16:33	07:04 07:30-08:05/35 17:10 08:05-08:19/14	06:24 17:45	06:31 06:54-07:07/13 19:21 07:07-07:36/29	05:45 06:11-06:18/7 19:54 06:43-06:54/11	05:18 06:01-06:26/25 20:23 06:26-06:34/8
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28	07:11 07:40-07:53/13 09:13-09:46/33 17:01 07:53-08:20/27	06:31 17:41	06:43 07:15-07:47/32 19:13	05:53 06:34-07:04/30 19:48	05:21 05:58-06:29/31 20:18 06:29-06:34/5	05:18 06:07-06:36/29 20:33
29	07:10 07:38-07:56/18 09:16-09:43/27 17:02 07:56-08:20/24		06:42 07:04-07:17/13 19:14 07:17-07:46/29	05:52 06:36-07:04/28 19:49	05:21 05:59-06:29/30 20:19 06:29-06:35/6	05:19 06:08-06:24/16 20:33 06:24-06:37/13
30	07:09 07:36-07:59/23 09:21-09:38/17 17:04 07:59-08:20/21		06:40 07:01-07:19/18 19:15 07:19-07:45/26	05:51 06:37-07:03/26 19:50	05:20 05:59-06:28/29 20:19 06:28-06:34/6	05:19 06:08-06:25/17 20:33 06:25-06:37/12
31	07:08 07:34-08:00/26 17:05 08:00-08:20/20		06:38 06:59-07:21/22 19:16 07:21-07:44/23		05:20 05:59-06:28/29 20:20 06:28-06:35/7	
Potential sun hours	294	296	370	401	451	456
Sum of minutes with flicker	2623	984	787	1075	940	891

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

Project: **Otis** Description: Real Case Shadow Flicker Assessment for Town of Otis - Algeria Rd. Site
 GE 1.7 103m Rotor 80m Hub
 Real Case Statistics:
 Average Percent of Possible Sunshine (APPS) Obtained from NOAA - National Climatic Data Center (www.ncdc.noaa.gov)
 APPS Gathered at Blue Hill Observatory in Milton, MA (Data Span 1896-2009)

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SHADOW - Calendar per WTG

Calculation: Otis Shadow Flicker - Algeria Rd. REAL CASE WTG: 1 - GE 1.7 103m Rotor 80m Hub

Assumptions for shadow calculations

Maximum distance for influence 2,000 m
 Minimum sun height over horizon for influence 3 °
 Day step for calculation 1 days
 Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) []
 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
 4.36 5.29 6.92 7.87 7.57 8.36 8.51 8.05 7.00 6.10 4.62 4.21

Operational time
 N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum
 442 226 352 623 302 199 233 473 992 1,070 1,285 2,170 8,367
 Idle start wind speed: Cut in wind speed from power curve

	July	August	September	October	November	December
1	05:20 06:08-06:27/19 20:33 06:27-06:38/11	05:45 06:10-06:40/30 20:14 06:40-06:41/1	06:17 06:42-07:05/23 19:28 07:04-07:19/15	06:49 07:12-07:39/27 18:35	06:25 06:58-07:38/40 16:47 07:38-07:44/6	07:01 07:28-07:46/18 16:22 08:31-09:46/75
2	05:20 06:08-06:27/19 20:33 06:27-06:38/11	05:46 06:11-06:39/28 20:13 06:39-06:40/1	06:18 06:42-07:02/20 19:26 07:01-07:19/18	06:50 07:13-07:37/24 18:34	06:26 06:58-07:38/40 16:46 07:38-07:45/7	07:02 07:30-07:45/15 16:21 08:31-09:47/76
3	05:21 06:08-06:29/21 20:33 06:29-06:39/10	05:47 06:12-06:38/26 20:11 06:38-06:39/1	06:19 06:42-06:55/13 19:24 06:54-07:19/25	06:51 07:14-07:35/21 18:32	06:27 06:58-07:37/39 16:45 07:37-07:46/9	07:03 07:32-07:44/12 16:21 08:31-09:47/76
4	05:21 06:07-06:29/22 20:33 06:29-06:39/10	05:48 06:12-06:37/25 20:10	06:20 06:43-07:09/26 19:23 07:09-07:19/10	06:52 07:15-07:32/17 18:30	06:29 06:59-07:37/38 16:43 07:37-07:47/10	07:04 07:34-07:42/8 16:21 08:31-09:48/77
5	05:22 06:08-06:31/23 20:32 06:31-06:40/9	05:49 06:13-06:36/23 20:09	06:21 06:43-07:08/25 19:21 07:08-07:19/11	06:53 07:18-07:29/11 18:29	06:30 06:59-07:36/37 16:42 07:36-07:48/12	07:05 08:31-09:49/78 16:21
6	05:22 06:08-06:32/24 20:32 06:32-06:40/8	05:50 06:15-06:34/19 20:08	06:22 06:44-07:06/22 19:19 07:06-07:18/12	06:54 18:27	06:31 06:59-07:35/36 16:41 07:35-07:48/13	07:06 08:31-09:50/79 16:21
7	05:23 06:08-06:32/24 20:32 06:32-06:40/8	05:51 06:16-06:32/16 20:07	06:23 06:46-07:04/18 19:18 07:04-07:18/14	06:55 18:25	06:32 07:01-07:35/34 16:40 07:35-07:50/15	07:07 08:31-09:51/80 16:20
8	05:24 06:08-06:33/25 20:32 06:33-06:41/8	05:52 06:18-06:30/12 20:05 06:56-07:00/4	06:24 06:48-07:01/13 19:16 07:01-07:30/29	06:57 18:24	06:33 07:02-07:34/32 16:39 07:34-07:50/16	07:08 08:31-09:51/80 16:20
9	05:24 06:07-06:33/26 20:31 06:33-06:41/8	05:53 06:51-07:05/14 20:04	06:25 06:48-07:17/29 19:14 07:17-07:32/15	06:58 18:22	06:35 07:02-07:33/31 16:38 07:33-07:50/17	07:09 08:31-09:52/81 16:20
10	05:25 06:07-06:35/28 20:31 06:35-06:41/6	05:54 06:49-07:07/18 20:03	06:27 06:49-07:16/27 19:12 07:16-07:33/17	06:59 18:20	06:36 07:04-07:33/29 16:37 07:33-07:51/18	07:10 08:32-09:53/81 16:20
11	05:26 06:08-06:36/28 20:30 06:36-06:42/6	05:55 06:47-07:08/21 20:01	06:28 06:50-07:15/25 19:11 07:15-07:34/19	07:00 18:19	06:37 07:05-07:31/26 16:36 07:31-07:51/20	07:11 08:32-09:54/82 16:20
12	05:27 06:08-06:36/28 20:30 06:36-06:43/7	05:56 06:46-07:10/24 20:00	06:29 06:50-07:13/23 19:09 07:13-07:35/22	07:01 18:17	06:38 07:07-07:29/22 16:35 07:29-07:51/22	07:12 08:32-09:55/83 16:21
13	05:27 06:07-06:36/29 20:29 06:36-06:42/6	05:57 06:44-07:11/27 19:57	06:30 06:52-07:11/19 19:07 07:11-07:36/25	07:02 18:15	06:40 07:10-07:28/18 16:34 07:28-07:52/24	07:12 08:32-09:54/82 16:21
14	05:28 06:07-06:37/30 20:29 06:37-06:43/6	05:58 06:43-07:12/29 19:56	06:31 06:54-07:08/14 19:05 07:08-07:36/28	07:03 18:14	06:41 07:12-07:25/13 16:33 07:25-07:52/27	07:13 08:32-09:55/83 16:21
15	05:29 06:07-06:38/31 20:28 06:38-06:43/5	05:59 06:42-07:12/30 19:54	06:32 07:04-07:36/32 19:04	07:04 18:12	06:42 07:14-07:51/37 16:32 08:42-09:21/39	07:14 08:33-09:56/83 16:21
16	05:30 06:08-06:39/31 20:28 06:39-06:44/5	06:00 06:41-07:13/32 19:53	06:33 07:04-07:37/33 19:02	07:06 18:10	06:43 07:15-07:52/37 16:31 08:41-09:24/43	07:15 08:34-09:57/83 16:21
17	05:31 06:07-06:38/31 20:27 06:38-06:43/5	06:01 06:40-07:13/33 19:52	06:34 07:03-07:37/34 19:00 07:37-07:39/2	07:07 18:09	06:45 07:15-07:52/37 16:30 08:39-09:26/47	07:15 08:33-09:57/84 16:22
18	05:31 06:07-06:39/32 20:26 06:39-06:44/5	06:02 06:40-07:13/33 19:50	06:35 07:03-07:36/33 18:58 07:36-07:41/5	07:08 18:07	06:46 07:15-07:51/36 16:29 08:38-09:28/50	07:16 08:34-09:58/84 16:22
19	05:32 06:07-06:40/33 20:26 06:40-06:44/4	06:03 06:39-07:14/35 19:49	06:36 07:03-07:36/33 18:57 07:36-07:42/6	07:09 18:06	06:47 07:15-07:51/36 16:28 08:36-09:30/54	07:17 08:35-09:59/84 16:22
20	05:33 06:08-06:40/32 20:25 06:40-06:44/4	06:04 06:39-07:14/35 19:47	06:37 07:03-07:35/32 18:55 07:35-07:42/7	07:10 18:04	06:48 07:17-07:52/35 16:28 08:36-09:32/56	07:17 08:35-09:59/84 16:23
21	05:34 06:08-06:41/33 20:24 06:41-06:44/3	06:05 06:38-07:14/36 19:46	06:38 07:03-07:34/31 18:53 07:34-07:43/9	07:11 18:03	06:50 07:17-07:51/34 16:27 08:35-09:34/59	07:18 08:36-10:00/84 16:23
22	05:35 06:08-06:41/33 20:23 06:41-06:45/4	06:07 06:38-07:13/35 19:44	06:39 07:03-07:33/30 18:51 07:33-07:43/10	07:13 18:01	06:51 07:18-07:51/33 16:26 08:34-09:35/61	07:18 08:36-10:00/84 16:24
23	05:36 06:08-06:41/33 20:23 06:41-06:45/4	06:08 06:38-07:13/35 19:42	06:40 07:03-07:32/29 18:49 07:32-07:43/11	07:14 18:00	06:52 07:19-07:51/32 16:26 08:34-09:37/63	07:19 08:37-10:01/84 16:24
24	05:37 06:09-06:42/33 20:22 06:42-06:45/3	06:09 06:38-07:13/35 19:41	06:41 07:05-07:31/26 18:48 07:31-07:44/13	07:15 17:58	06:53 07:20-07:50/30 16:25 08:33-09:38/65	07:19 08:37-10:01/84 16:25
25	05:38 06:08-06:41/33 20:21 06:41-06:44/3	06:10 06:38-07:12/34 19:39	06:42 07:06-07:29/23 18:46 07:29-07:44/15	07:16 17:57	06:54 07:21-07:50/29 16:24 08:32-09:39/67	07:20 08:37-10:01/84 16:25
26	05:39 06:08-06:41/33 20:20 06:41-06:43/2	06:11 06:38-07:12/34 19:38	06:43 07:08-07:27/19 18:44 07:27-07:43/16	07:17 17:55	06:55 07:22-07:49/27 16:24 08:32-09:40/68	07:20 08:38-10:02/84 16:26
27	05:40 06:09-06:41/32 20:19 06:41-06:43/2	06:12 06:38-07:12/34 19:36 07:11-07:14/3	06:44 07:10-07:24/14 18:42 07:24-07:43/19	07:19 17:54	06:57 07:23-07:49/26 16:23 08:31-09:41/70	07:20 08:38-10:02/84 16:27
28	05:41 06:09-06:41/32 20:18 06:41-06:43/2	06:13 06:39-07:11/32 19:34 07:10-07:15/5	06:46 07:11-07:42/31 18:41	07:20 17:53	06:58 07:25-07:49/24 16:23 08:32-09:43/71	07:21 08:39-10:02/83 16:27
29	05:42 06:09-06:41/32 20:17 06:41-06:43/2	06:14 06:39-07:10/31 19:33 07:09-07:17/8	06:47 07:11-07:41/30 18:39	07:21 17:51	06:59 07:26-07:48/22 16:22 08:31-09:44/73	07:21 08:39-10:02/83 16:28
30	05:43 06:10-06:41/31 20:16 06:41-06:42/1	06:15 06:40-07:09/29 19:31 07:08-07:18/10	06:48 07:11-07:40/29 18:37	07:22 17:50	07:00 07:27-07:47/20 16:22 08:31-09:45/74	07:21 08:40-10:02/82 16:29
31	05:44 06:10-06:40/30 20:15 06:40-06:41/1	06:16 06:41-07:07/26 19:29 07:06-07:18/12		07:24 17:48		07:21 08:41-10:04/83 16:30
Potential sun hours	463	430	375	344	295	284
Sum of minutes with flicker	1060	911	1135	623	2184	2587

Table layout: For each day in each month the following matrix apply

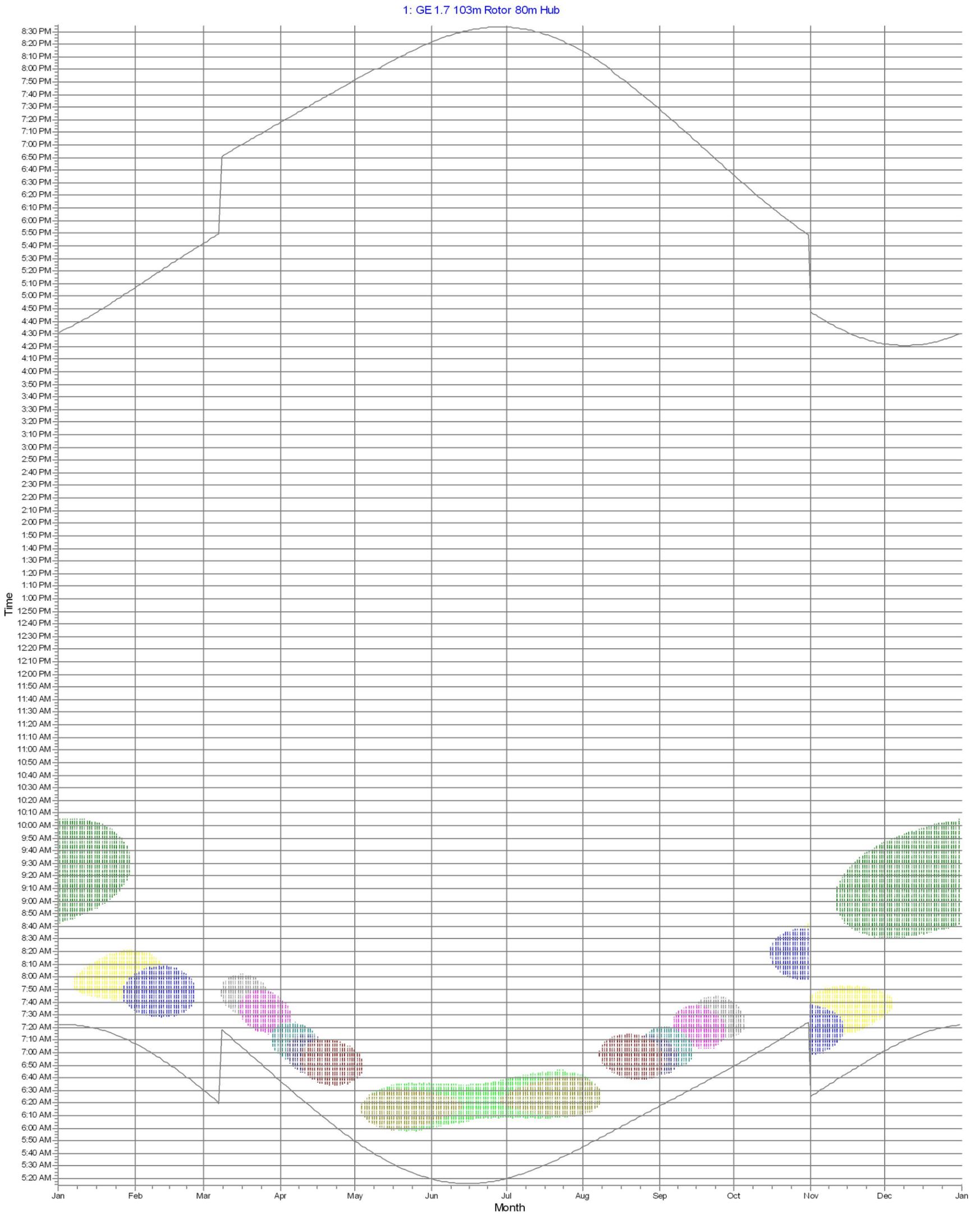
Day in month Sun rise (hh:mm) First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
 Sun set (hh:mm) First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

Project: Otis
 Description: Real Case Shadow Flicker Assessment for Town of Otis - Algerie Rd. Site
 GE 1.7 103m Rotor 80m Hub
 Real Case Statistics:
 Average Percent of Possible Sunshine (APPS) Obtained from NOAA - National Climatic Data Center (www.ncdc.noaa.gov)
 APPS Gathered at Blue Hill Observatory in Milton, MA (Data Span 1896-2009)

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 Scott Abbett / scott.abbett@sed-net.com
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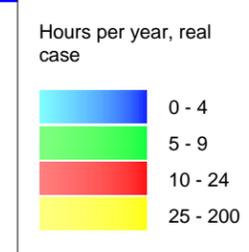
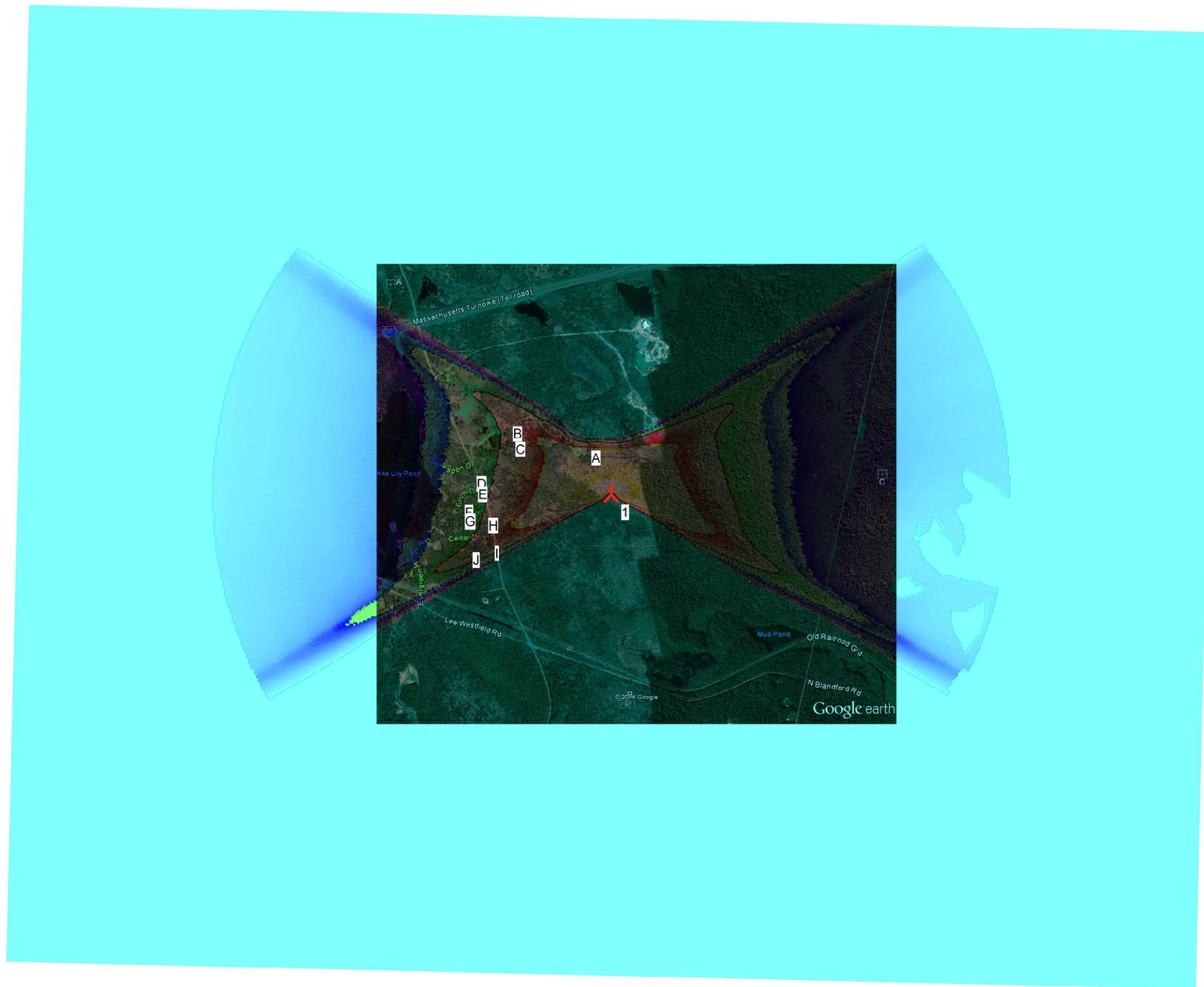
SHADOW - Calendar per WTG, graphical

Calculation: Otis Shadow Flicker - Algerie Rd. REAL CASE WTG: 1 - GE 1.7 103m Rotor 80m Hub



Shadow receptor

- | | | | | |
|--|--|---|---|---|
| A: SR1 | C: SR2 | E: SR9 | G: SR10 | I: SR14 |
| B: SR3 | D: SR7 | F: SR10A | H: SR11 | J: SR15 |



Project:
Otis

Description:
Real Case Shadow Flicker Assessment for
Town of Otis - Algeria Rd. Site
GE 1.7 103m Rotor 80m Hub
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Center (www.ncdc.noaa.gov)
APPS Gathered at Blue Hill Observatory in
Milton, MA (Data Span 1896-2009)



Map: Georef Alternate Site Sat Image , Print scale 1:25,000, Map center UTM WGS 84 Zone: 18 East: 662,920 North: 4,676,710



**SHADOW -
Map**

Calculation:
Otis Shadow Flicker - Algeria Rd. REAL CASE
WTG:
1 - GE 1.7 103m Rotor 80m Hub

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